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Elk Habitat Relationships for Central Idaho

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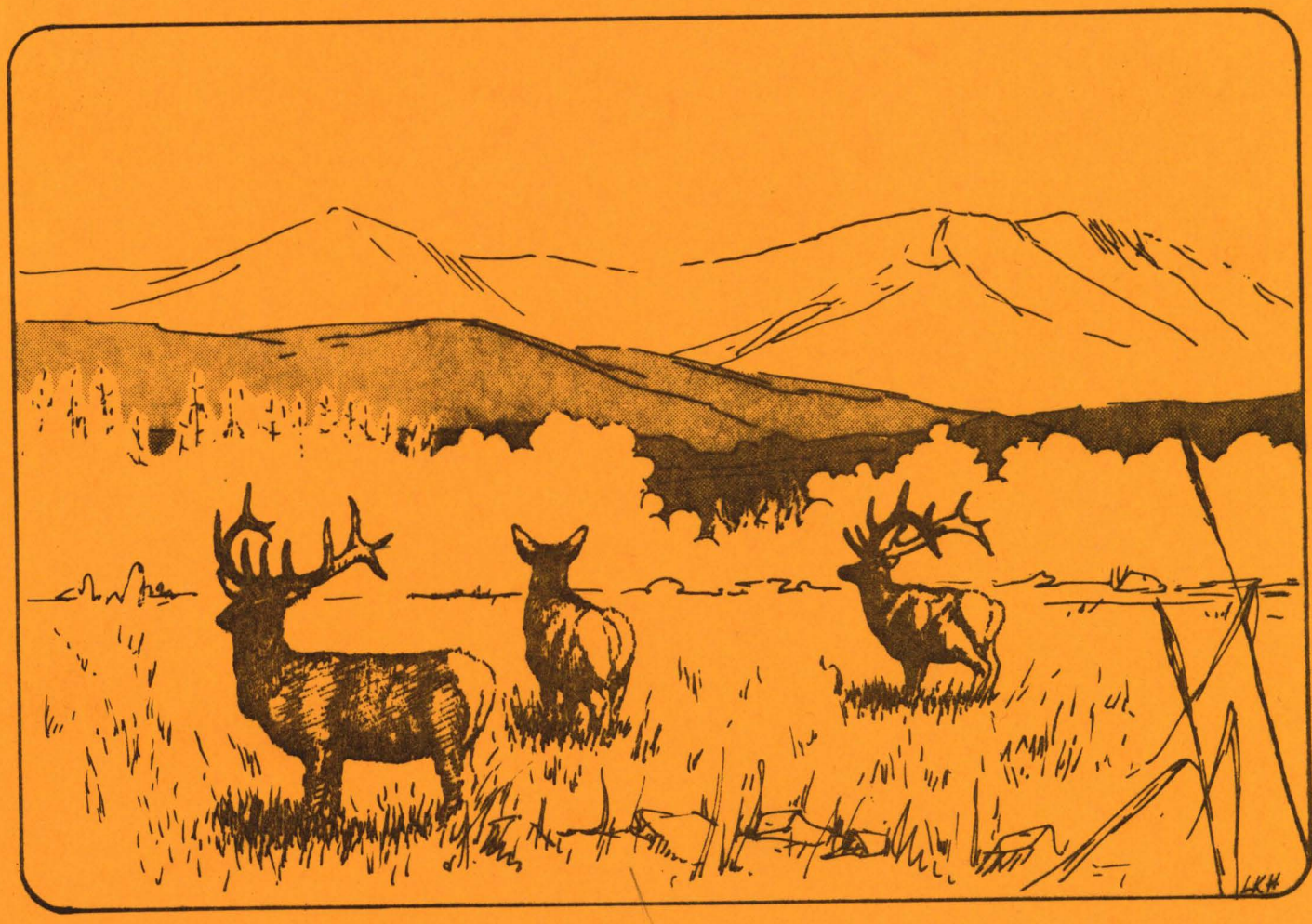

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ELK HABITAT RELATIONSHIPS
FOR
CENTRAL IDAHO

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FOREWORD

Elk are an important resource of central Idaho, both to the consumptive user (hunters) and non-consumptive user (wildlife watchers and photographers). Timber, grazing, and mining, along with the associated roads, are also important resources. Unfortunately, lacking certain safeguards and considerations, the latter resources may detrimentally affect both elk and their habitat.

This report was written by a highly qualified team representing the Forest Service, Bureau of Land Management, Idaho Department of Fish and Game, and the University of Idaho.

The information presented is based on a wealth of published and unpublished research findings, communication with range and wildlife research scientists, range conservationists, foresters, long-time residents, and discussions between participants.

It is intended to be informational and used as a working tool to help evaluate the effects of various proposals on elk use. It is meant to identify trade-offs and mitigation measures, and to display potential alternatives for consideration by land managers. On-site interdisciplinary team evaluation of each situation is still essential as a basis for decisionmaking.

The team has written general recommendations that are designed to give the manager the most flexibility to manage elk habitat based on all land management activities. The recommendations are presented as the best and most up-to-date management practices for the perpetuation of elk habitat on National Forests, and the Natural Resource lands of central Idaho.

The Idaho Department of Fish and Game is an integral part of applying these relationships and should be included so that elk numbers and trends can be considered. Also, game numbers and habitat should be monitored to determine if management objectives are being met.

This document was patterned after those currently in use in other areas of elk habitat in the Western United States. The team acknowledges the use of many of their ideas and wishes to credit the authors, whose names appear in the "References" section.

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ELK HABITAT RELATIONSHIPS FOR CENTRAL IDAHO

INTRODUCTION

History

Rocky Mountain elk *(Cervus elephus nelsoni)* have roamed the mountains in central Idaho since prehistoric times. The archaeological record, which is confirmed by present conditions, indicates that central Idaho is on the periphery of two major elk producing areas, namely, northern Idaho and the Yellowstone Region. Lewis and Clark, the first white men to document the presence of elk in the area, recorded in 1805 seeing a herd of elk "among the pines on the mountainside" several miles below the confluence of the Lemhi and Salmon rivers (Coues 1893). Numerous other explorers and trappers observed elk in this region for several decades (Morgan 1953; Work 1923).

The 1860's ushered in the mining era, with attendant heavy demand for big game for subsistence. Market hunting developed and flourished until about 1900. Meanwhile, the influx of population and the consequent increase in settlements and cultivated lands diminished supplies of forage for elk and further contributed to the decline of their population. In a personal letter written in 1935, George Shoup[1/] estimated that unregulated livestock use of range had reduced range productivity by 50 percent by 1882. An entry in an anonymous History of Idaho Territory (1884) stated: "They (elk) are now found in small numbers in the northern counties and occasional bands in several interior sections. They will soon be exterminated." This dire prediction almost came true, and during the first 30 years of the 1900's, elk were virtually nonexistent in the mountains of central Idaho.

Some elk, mostly from Yellowstone, were transplanted into this region between 1917 and 1942. These scattered population cells built slowly, and by the late 1940's, much of the historic range had been reoccupied. The devastating winter of 1949 considerably reduced these flourishing herds, but recovery was fairly rapid. Long-time residents agree that the high population years for elk were from the mid-1950's through most of the 1960's. These residents also state that hunting pressure, building of "too many" new roads, and too many people invading natural elk habitat over these roads have caused obvious reduction of these herds in the late 1960's and early 1970's. Management has recognized declining elk habitat and numbers. Recently, in many instances, state and Federal agencies have addressed the problem and positive results are evident. Through coordination with other resources and habitat improvements, elk numbers can be increased to levels equal to or greater than those occurring in the 1960's.

Present Situation

Increasing demands for timber products, livestock production, and use of off-road recreation vehicles (ORV) pose very real threats to the welfare of elk and to their habitat. If all these demands are met without using adequate

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1/ George Shoup was a long-time central Idaho merchant, large cattle operator, and the first Governor of Idaho.

protective and mitigative measures, long-term - perhaps permanent - reductions in the elk population are inevitable.

A few years ago, Black, Scherzinger, and Thomas (1976) developed procedures for coordinating forest land activities with the habitat needs of elk and deer in the Blue Mountains of Oregon and Washington. These procedures were refined and modified as needed and have been used successfully in development of practices for maintaining elk habitat while timber harvesting and related forest land uses continue in northern Idaho (Carrier et al., 1977).

Wildlife biologists from the Idaho Department of Fish and Game, the U.S. Forest Service, the Bureau of Land Management, and the University of Idaho began development in March 1979 of a similar system for use in the central Idaho mountains. Specifically, the area they were concerned with includes most of the Sawtooth National Forest, all of the Challis and Salmon National Forests, and portions of the Shoshone, Idaho Falls, and Salmon Districts of the Bureau of Land Management (Figure 1). Most of the procedures developed previously for northern Idaho dealt with timber harvesting and were appropriate for direct inclusion with the elk relationships for central Idaho. Whatever was not appropriate was either deleted or modified to accommodate recognized differences between habitats in the two intrastate regions. These major differences are:

1. The proportion of stringers and patches of timber is greater in central Idaho than in northern Idaho; and

2. Topography is rougher, the climate is dryer, extremes of elevation are greater, and seral brushfields are fewer and less extensive in central Idaho.

The practices previously recommended for northern Idaho were limited primarily to timber management and the building and use of roads on elk summer range. By contrast, the present central Idaho effort includes year-round considerations of roads, livestock management, ORV use, and timber management.

The recommendations presented in this paper are based on a wealth of published and unpublished research findings, communications with elk research biologists, range conservationists, foresters, and discussions between participants in this coordinating effort. They are intended to be used as an information source. On-site interdisciplinary team evaluation of each situation is still essential as a basis for decisionmaking. These recommendations will have to be updated and modified as new information becomes available.

Objective

The objective of this report and its recommendations is to provide land managers in the central Idaho mountain area a system by which they can evaluate and mitigate the effects of timber harvesting, roadbuilding, ORV use, and livestock management practices on Rocky Mountain elk and their habitat. They are meant to identify opportunities for optimizing elk habitat, to display relationships of cause and effect, identify trade-offs, and to provide alternatives for consideration in making decisions about land use. They leave the balancing of different resources to the land managers.

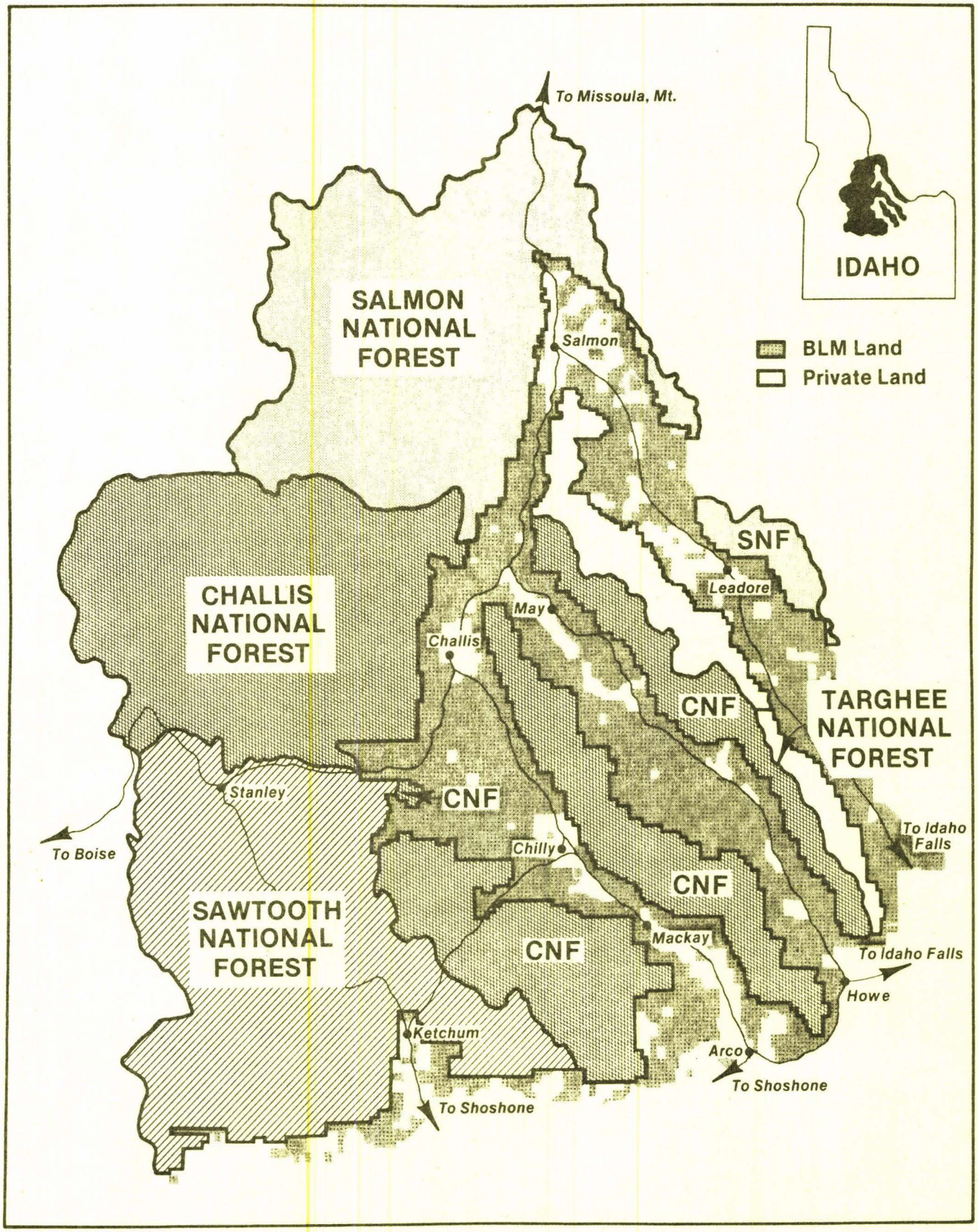


FIGURE 1. Vicinity map.

The recommendations herein can be used at the following levels:

1. Long-range planning: basis for allocating land for either immediate or possible future use as elk habitat.

2. Short-term planning: identifying coordination needs for proposed resource plans (e.g., AMPS, 5-year timber plans, etc.).

3. Project level: assist land managers in recognizing effects of potential proposed actions on elk habitat; assist land managers in designing proposals which minimize impacts, maintain or improve elk habitat; and identify specific points of concern for evaluation in environmental assessments and interdisciplinary team assignments.

Scope

This report describes components of key elk habitats in mountainous areas of central Idaho, the seasonal patterns of use of these habitats, and actions which can impact elk habitat and use. It also provides recommendations for reconciling land management activities and use with the requirements of adequate habitat for elk. The "Applications" section includes a report form that can be used for evaluating potential elk habitat use before and after various activities and levels of use (grazing, mining, logging, roads, and their use). Table 5 in the Appendix lists plants used by elk for food.

Assumptions

1. Demand for elk will continue to increase because of high economic and aesthetic values.

2. Demand for other market resources (timber, minerals, livestock grazing) and nonmarket resources (recreation opportunities) will continue to increase.

3. Accommodating rising demands for these resources may not be compatible with maintaining elk populations or their habitat.

DEFINITIONS

Certain terms used frequently in this report describe relations between elk and their requirements for habitat. To promote uniform understanding and to avoid misinterpretation of these terms, they are defined below.

Breeding Area Complex

Moist areas with associated wallows, rub trees, and/or dense cover that elk use extensively during late summer and early fall for breeding and/or breeding-related activities.

Cover:Forage Ratio

The ratio of area in hiding and/or thermal cover to area in forage. The optimum spring-summer-fall habitat cover:forage ratio is 40:60 in most habitat types with 20 percent of the cover in hiding cover, 10 percent in thermal cover, and 10 percent in either hiding or thermal cover. Areas that have less forage or cover will have correspondingly fewer elk. The exception to this rule occurs in areas having a high water table, cool temperatures, and succulent vegetation. Elk make extremely heavy use of these areas. In these habitat types, maximum elk use occurs when the cover:forage ratio is 75:25.

Crucial Winter Range

That portion of the winter range that elk use during the most severe portions of the winter season and that is essential to survival and perpetuation of an elk herd or population; often called "key winter range" or "critical winter range."

Forage Area

Elk habitat that does not qualify as either hiding cover or thermal cover; excludes such natural barren areas as talus, rock outcrops, rivers, and lakes.

Habitat Type

The aggregation of units of land capable of producing similar plant communities at climax (Pfister et al., 1974).

Hiding Cover

Coniferous or dormant deciduous vegetation on spring, summer, and fall ranges that can hide 90 percent of an elk's body from human view at a distance equal to or less than 200 feet (61 m). Topography can augment vegetative cover. Because of the extreme variability in topography, it is professional judgment as to its effectiveness. Therefore, a wildlife biologist should evaluate each situation on a case-by-case basis.

Home Range

The total land area in which an elk finds all its requirements for food, cover, water, and security at a particular time of the year. Use of a home range appears to be governed by interspersion of requirements and previous habits. Between June 1 and November 15, the average home range in central

Idaho is 4,000 acres (1,620 ha) (Will 1979). Zahn (1974) and Ream et al., (1974) reported similar-sized home ranges in other areas.

Key Habitat Components

Certain physical components of seasonal elk habitat receive exceptionally heavy use. These components include calving areas, crucial winter range, security areas, migration routes, travel lanes, breeding areas (wallows), rub areas, moist sites, and licks. Loss or alteration of any of these may cause a decline or displacement in elk numbers by reducing survival and/or productivity. These habitat components are discussed in detail later in this paper.

Normal Winter Range

The area occupied by elk during all but the mildest winters (1976-1977) and the most severe winters.

Potential Elk Habitat Use

Habitat that is evaluated and rated for its potential use by elk (the availability of elk to use the habitat is not a consideration). Biologists will consider existing elk numbers in an area when applying these relationships and making recommendations.

Security Area

An area that, because of its size, remoteness, topography, and vegetation can shelter elk during periods of stress. Size of such an area varies with the combination of space and hiding cover necessary for the existing number of elk to feel psychologically secure.

Sight Distance

Distance within coniferous or dormant deciduous vegetation at which 90 percent of an elk's body is hidden from human view.

Suitable Habitat

Any area in which the combined effects of intrinsic factors (e.g., cover, forage, space) allow elk to use and remain in that area in spite of extrinsic influences (e.g., climate, human activities, livestock competition, etc.).

Thermal Cover

Coniferous vegetation that is 40 feet (12 m) or more in height has at least 70 percent average crown cover and moderates extremes of ambient temperature. On summer ranges above 7,500 feet (2,286 m) elevation, coniferous vegetation having at least 50 percent average crown cover qualifies as thermal cover. Aspect and slope can also have a significant influence on summer thermal cover. North facing slopes can provide thermal cover in areas where crown cover is less than the recommended optimum of 50 to 70 percent. Often, the best indicator of thermal cover is heavy elk use during July and August. On winter ranges, size of individual trees and stand location is more important than overall crown cover.

KEY HABITAT COMPONENTS

Within each of the seasonal ranges of elk, certain components of habitat areas receive extremely heavy use. These key habitat components include moist sites, security areas, crucial winter range, wallows, migration routes, travel lanes, calving areas, licks, rub areas, and other heavily used areas. Such habitat often is the central core of a much larger area occupied in a given season. Key habitat components are easily identified by the concentration of animals, numerous pellet groups, or other signs of heavy use. If one of these key components is adversely affected, it may result in a reduction of elk use over a larger habitat area and may adversely affect herd productivity.

Moist Sites

Most reported studies of elk habitat use mention the association of elk with moist swales, sedge meadows, streams, and seeps or bogs (Leege et al., 1976; Marcum 1976:Lonner 1978).

In central Idaho, such moist sites are often associated with the highest, unbranched drainage or cirque basins, with high altitude meadow types, and with the fir *(Abies spp.)* and spruce *(Picea spp.)* habitat series. In addition, numerous moist sites are associated with topographic situations independent of habitat type. Bench areas and swales where surface water accumulates are often extremely important. Because much of the elk range in central Idaho is steep and dry, most local moist areas are small, scattered, and even more important than they are in much of the rest of the North American elk range. The Montana Cooperative Elk-Logging Study Report (Lyon 1975) stressed the importance of moist sites to elk summer range.

Moist areas serve several important functions. The succulent forage they produce is valuable throughout the summer and may be a nutritionally significant factor in reproduction (Allen 1978). Moist sites often provide thermal cover and security cover on summer range, and they are used heavily before and during the breeding season. Often, most or all of the needs of elk can be met within these small areas during the summer/early fall period. Forage availability prior to the critical winter period may be more important than availability of forage during the winter period. This is because elk can go for long periods with little forage intake if they have high body fat reserves (Holechek 1980).

Wallows

Elk wallows are a very specific and special kind of moist area--usually a shallow, muddy, foul-smelling depression in which animals lie down or roll (Lemke 1975; Struhsaker 1976). Both cows and bulls use wallows at various times of the year; in summer they provide a means of cooling off on hot days and give relief from insects and parasites (Lemke 1975; Zahn 1974). However, the apparent function of wallows during the rut appears to be most important. The erratic and bizarre behavior of bull elk at this time includes profuse urination into the wallow (Struhsaker 1967), attacks on nearby vegetation (Harper et al., 1967; McCullough 1969), and bugling at intervals (de Vos et al., 1967). Wallows may maintain a better distribution of animals during the

rut (Altman 1952). Although there is no evidence yet that the amount of wallowing is directly related to success in breeding, interference with any behavior so closely related to breeding should be considered as potentially detrimental (McCullough 1969).

Migration Routes and Travel Lanes

Certain elk herds in central Idaho have habitually moved from summer range to winter range along known and described routes of travel (Grkovic 1976). These herds are extremely vulnerable to displacement and hunting wherever the width of the travel zones is compressed by topography, roads, or timber harvesting. Unless special consideration is given to management of these zones, displacement or elimination of elk from acceptable habitat can result.

Locally, daily movement from forage to cover areas and between drainages very often follows identifiable and well-used trails. Dense cover areas adjacent to roads and in saddle areas on ridges have been identified as important in maintaining access to elk range (Allen 1978).

Calving Areas

This term is applied to areas where cow elk repeatedly give birth. The concept is not universal because the location of such areas often results from simple coincidence as elk follow the retreating snowline in spring. However, in some parts of central Idaho, calving areas appear to be highly predictable. Phillips (1974) found that potential elk-calving areas often could be visually identified on aerial photos or from the air. In his study area on the Sawtooth National Forest, he noted the following characteristics of identified calving areas:

1. Conifer timber types, usually mixed with aspen, adjacent to openings dominated by sagebrush and/or meadow.

2. Situated at or near the head of a drainage.

3. On moderate slopes at mid to high elevations.

4. Usually on north or easterly exposures.

Davis' earlier observations (1970) showed similar characteristics on his study areas on the Salmon National Forest. Calving areas on the Challis National Forest are also found in the same environmental conditions. On both of these Forests, there is also calving on southerly aspects.

Exception to this general rule occurs on the heavily timbered North Fork Ranger District of the Salmon National Forest; no well-defined calving areas have been found there. On that District, several well-defined migration routes between winter ranges in Idaho and summer ranges in Montana have been documented (Grkovic 1976), with strong indications that calving occurs in traditional areas in Montana. Almost any area at lower elevations on or near winter range could become important for calving in years when snowmelt is delayed.

Licks, Rub Areas, Other

Several other kinds of heavy use areas, such as licks and rub areas, provide additional evidence of the presence of elk. Usually it has not been possible to prove that heavy use of such areas is absolutely essential to elk existence (Murie 1951; Dalke et al., 1965). Nevertheless, disturbance of such areas is usually disruptive, and it is likely to prevent full utilization of existing habitat.

Crucial Winter Range

Throughout most of central Idaho, crucial winter range consists of a small percentage of the total land area and is considered to be a major factor limiting the number of elk that can be supported. On winter range, both forage and cover are critical elements and they require consideration in all phases of planning. Where forage is lacking, artificial feeding grounds may be necessary, but only under emergency conditions. Establishing them is expensive and requires intensive management coordination.

Security Areas

When human intrusions are frequent, an elk's need for security increases greatly. Roads introduce most man-associated disturbances onto elk ranges (Figure 2, page 10). The security needs of elk in an area depend mainly on: (1) activity levels on roads; (2) activity levels emanating from roads; (3) forest density in the area; and (4) location and densities of roads. Size and location of security areas will vary accordingly.

Thiessen (1976) reported that 65 percent of 110 hunters interviewed had killed their elk in roadless areas of Idaho's heavily hunted Game Management Unit 39. These areas comprised only 25 percent of the timbered portions of the drainage. Bodie[1/] reports that data from check stations (1974 through 1976) in the Salmon National Forest show that for 291 elk harvested in Idaho Game Management Units 21, 21-A, and 28, the average distance from a road was 1.33 miles (2.14 km).

The effects of human-associated disturbances on elk are well documented (see also Roads, page 17 and Table 1, page 19) and demonstrate that elk prefer unroaded security areas as part of their overall habitat. Figure 2 should be used only to show a general relationship. An experienced wildlife biologist should be consulted to determine size and location of these areas on the ground. The graph is adapted from Elk Habitat Guidelines for Northern Idaho, and the authors feel it is applicable to central Idaho.

1/ Personal communication in 1980.

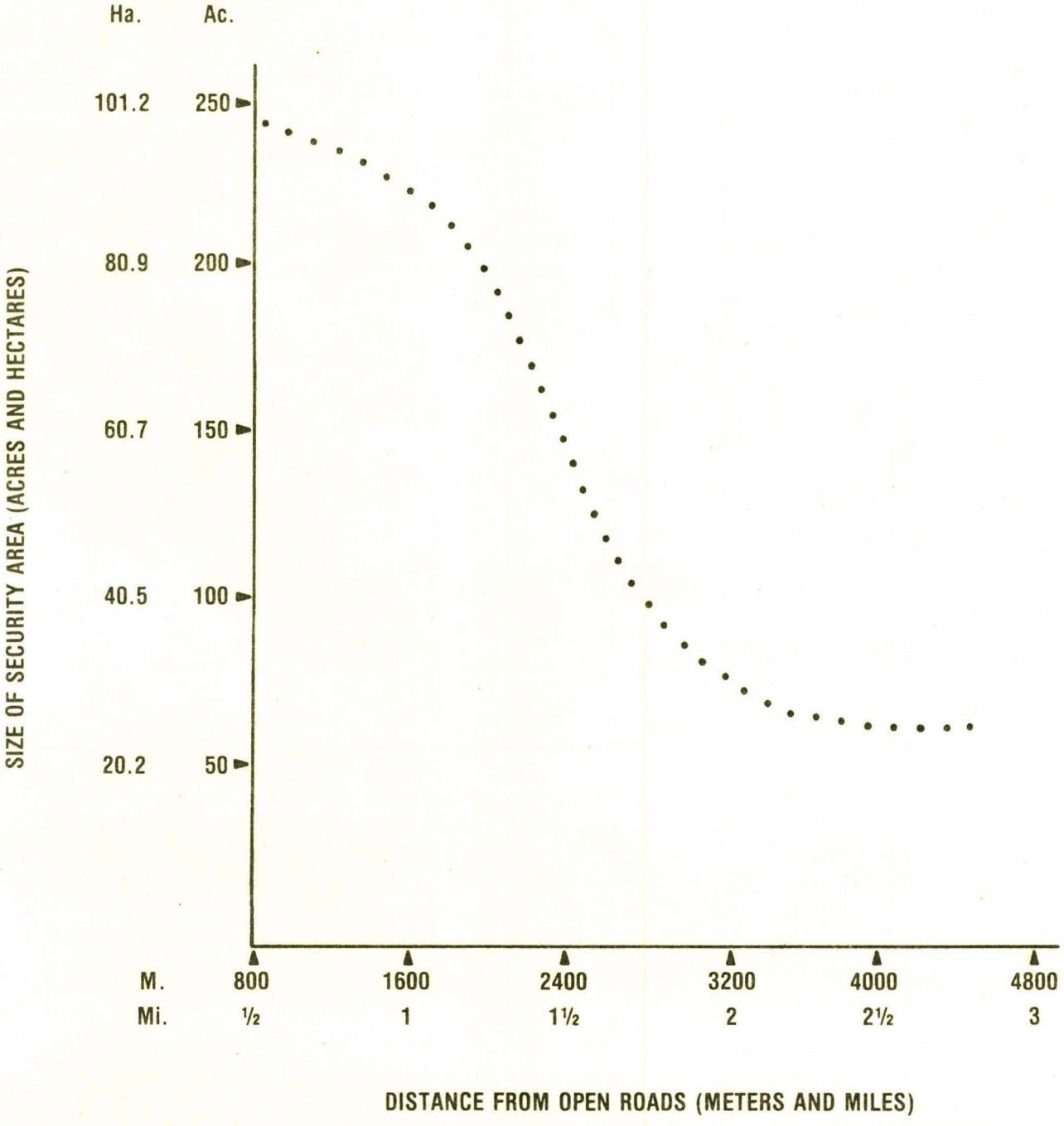


FIGURE 2. Relation between the size of area necessary for security areas for elk and distances from open roads.

SEASONAL PATTERNS OF HABITAT USE

Elk can adapt to widely varied habitats. Murie (1951) stated, "Elk as a genus are tolerant of diverse environments, as shown by their original wide distribution over the American continent and by their varied habitats today." Patterns of habitat selection are not yet well documented for central Idaho, but they can be inferred from local studies, studies in similar areas elsewhere, and experiences of local biologists and long-time residents. The present discussion centers around seasonal requirements for forage, cover, water, and space.

Spring

Studies in central Idaho indicate elk use of habitat during spring is strongly associated with mountain big sagebrush *(Artemisia tridentata vaseyana)* habitat types. Wittinger (1978) observed the greatest use in this habitat on the East Fork of the Salmon River, along with riparian zones and adjacent Douglas-fir *(Pseudotsuga menziesii)* timber types. Davis earlier (1970) had observed this on his study area in the Salmon National Forest and found it to be closely associated with calving activity. Dalke et al., (1965) stated that availability of green forage in spring strongly influenced habitat use. Idaho fescue *(Festuca idahoensis)*, bluebunch wheatgrass *(Agropyron spicatum)*, elk sedge *(Carex spp.)*, and numerous forbs are locally important and are abundant over all of central Idaho.

Summer

Summer range provides elk a large variety of habitats from which to select. In most areas in central Idaho, elk prefer mesic habitats at high elevations where Douglas-fir gives way to subalpine fir *(Abies lasiocarpa)*. Favored areas are cirque basins and stands of dense timber interspersed with wet meadows or parks; researchers in Montana (Kirsch 1962; Coop 1971; Baglien and Biggins (1976) have also found this to be true. Highest densities of summering elk usually appear at elevations between 7,500 and 10,000 feet (2,286 and 3,048 m), on slopes less than 40 percent, and where wet meadow openings cover 25 to 75 percent of a given land area. Wittinger (1978) noted a major exception to this rule on the East Fork of the Salmon River where openings approximated 90 percent of the area. The authors feel this use is probably related more to the unroaded nature of the area. Marcum (1976) found that elk prefer forested areas less than 1,150 feet (350 m) from water, especially areas near the heads of drainages. Elk diet in summer shows heavy use of forbs plus moderate use of grass and grasslike plants (Davis 1970; Wittinger 1978; and Yeo 1980).

Fall

As herbaceous vegetation cures and the breeding season approaches, elk shift from open areas to dense mesic timber types. On the Salmon, Challis, and Sawtooth National Forests, dense stands of subalpine fir, lodgepole pine *(Pinus contorta)*, and Englemann spruce *(Picea englemanii)* close to streams are most heavily used. Douglas-fir is equally important on the Sawtooth National Forest. Wallows, which function in social activities associated with the rut, are most often in high, unbranched drainages. Lemke reported (1975)

two-thirds of fall radio locations of elk in Montana were within 0.1 mile (0.16 km) of water. During late fall storms, elk shift from heavy timber to adjacent open slopes, where they become vulnerable to hunters (Bohne 1974). Since green forage is less available in the fall, elk consume any available green grass or grasslike vegetation.

Winter

During winter, snow usually drives elk to lower elevations (where snow depths are less) but not low enough to enter the zones of cold air entrapment (inversions) that prevail in many central Idaho valleys.

In a normal winter, upper elevation of winter range is approximately 6,500 feet (1,980 m) along the lower Salmon River (area of high snow accumulations); the range is higher upstream--to near 9,000 feet (2,743 m) on the Lemhi River and the East Fork Salmon River. In severe winters, crucial winter range in these same locations is no higher than 5,000 and 8,000 feet (1,524 and 2,439 m), respectively.

The most heavily used winter range situation in central Idaho is one where an abrupt east-west oriented ridgetop lies between Douglas-fir and sagebrush/grass habitats. At the north end of the central Idaho zone (lower elevations), ponderosa pine *(Pinus ponderosa)* replaces Douglas-fir as the dominant tree species. Timbered north-facing stringers provide needed thermal cover (Beall 1974) and south-facing slopes provide forage. In years when snow is unusally deep or crusted, timbered areas are also used for foraging. On the North Fork Ranger District of the Salmon National Forest, elk often find winter forage on the fire-created seral brushfields in both the main Salmon River canyon and the North Fork of the Salmon River.

Bedding areas often are on ridgetops and on the upper one-third of a slope. These areas are often associated with rocky slopes which support stands of mountain mahogany *(Cercocarpus ledifolius)*, an important winter browse species (Lauer 1973). Occasionally, large bulls, and to a lesser degree cows and calves, winter on high elevation windswept ridges.

RECONCILING LAND MANAGEMENT ACTIVITIES WITH REQUIREMENTS FOR ELK HABITAT

A. TIMBER HARVEST

The cover:forage ratio concept is used to describe optimum habitat for elk (Carrier et al., 1977; Thomas et al., 1980). Removing coniferous trees from a given area by logging affects the balance between cover and forage and may also disrupt elk movements and distribution. This altered balance may affect elk use of that area. The recommendations in this chapter adapt the concept of cover:forage ratio for use in central Idaho.

Another basic concept is that all positive manipulations of habitat can be negated by human disturbance. This is especially true when human access to elk habitat continues on either a long-term or permanent basis. Unhunted populations, such as those in National Parks, tolerate the presence of people (Rost and Bailey 1979) but hunted populations are considerably less tolerant.

Presence of slash in timber sale areas may also reduce elk use (Lyon 1976) and must be considered.

1. Cover and Forage Requirements

Thomas et al., (1980) stated that optimum cover:forage ratios on elk summer range can be created and maintained through harvesting timber. They determined that optimal habitat for elk in summer in northeastern Oregon consists of 60 percent forage areas, 20 percent hiding cover, 10 percent thermal cover, and 10 percent either hiding or thermal cover, assuming proper justaposition and size of all these components. Elk very often accept less than optimum forage and cover conditions, but at reduced levels of use.

Recommendations

The authors consider the cover:forage ratio of 40:60 optimum for central Idaho for most habitat types (see Figure 4, page 27). To provide the optimum range of conditions for the needs of elk, the following cover:forage criteria for designing timber sales and thinning operations are recommended:

a. Provide hiding cover patches from 3 to 6 sight distances (600-1200 feet) wide (183 - 366.6 m). These dimensions will provide patches of 11.5 to 46 acres (4.5 - 18.6 ha).

b. Provide patches of thermal cover 30 to 60 acres (12 - 24 ha).

c. Patches of hiding and thermal cover smaller than optimum are also valuable to elk and should be retained in areas where cover is deficient. A wildlife biologist can provide advice about those questionable areas.

d. Forage areas created by logging should have no point more than 600 feet (183 m) from the edge of cover; elk use decreases rapidly beyond this point. A circular forage area 1,200 feet (366 m) in diameter is approximately 26 acres (10.5 ha).

2. Human Disturbance

Normal patterns of elk use of an area are strongly influenced by season and the length of time during a year that logging and roadbuilding cause disturbance (Lyon 1975; Ward 1976).

Recommendations

Conflicts between elk use and logging activity can be reconciled to mitigate adverse effects of displacement of the animals by:

a. Designing sales so they concentrate disturbance into the least forest area for the shortest possible time.

b. Building roads and logging on areas containing key habitat components during periods when animals are not present. This is especially important on:

- o Migration Routes. The period varies according to site and season.
- o Calving Areas. The critical period is from May 1 until July 15.
- o Breeding Areas (wallows, etc.). The critical period is from September 1 until September 30.
- o Crucial Winter Range. The critical period is from December 1 until April 15. This is extremely important on helicopter sales.

c. Designing sales so adjacent suitable summer range is available for elk during periods when disturbance-causing land uses (i.e., logging, roading) cannot be avoided.

3. Slash Disposal

Accumulation and treatment of logging debris are inherent in any timber harvest. Slash can unfavorably affect elk behavior and movement in both the cutover area and adjoining uncut areas (Lyon 1976). The method of slash disposal also affects the vegetative response of forage species used by elk (Mueggler 1965; Pengelly 1966; Edgerton 1972; Dyrness 1973; Hall 1977).

Recommendations

Suitable elk habitat can be maintained through slash disposal by:

a. Reducing depth of slash to less than 1.5 feet in cutting units and along roadsides.

b. Providing for the disposal of slash within a reasonable time period; two years is usually sufficient and will allow time for firewood collecting, etc.

c. Providing the maximum volume of palatable elk forage by using the appropriate method of slash disposal. Based on the experience of local

biologists, the following relative value index was developed and can be used as an indicator by which effectiveness of the methods can be compared. The relative value index will be used to determine potential elk use based on forage production in the "Application" section.

Method of Tree Harvest	Method of Slash Disposal	Relative Value* Index
Clearcut	Broadcast burn	10
	Dozer pile and burn	5
	Lop and scatter	2
Seed tree/shelterwood	Broadcast burn	8
	Dozer pile and burn	4
	Lop and scatter	2
Thinning/salvage/overstory	Hand pile and burn	3
	Lop and scatter	2

* Highest number indicates greatest forage value.

4. Managing Key Habitats

Certain physical components of seasonal elk habitats, notably calving areas, crucial winter range, migration routes and travel lanes, breeding areas (wallows and rub areas), moist areas, licks, and security areas receive especially heavy use. These key areas are sensitive enough that maintenance of hiding and thermal cover in and around them is important in preserving the integrity of the total habitats (Beall 1974; Roberts 1974; Allen 1978).

Recommendations

a. Timber harvest on key elk habitats should be limited to those activities that will maintain or enhance the habitat for that particular elk use. A wildlife biologist should be consulted for delineation of all such key areas, and a silviculturist should work closely with the biologist to take advantage of opportunities to maintain the value of these key areas. Critical cover patches and buffers can be maintained over time by applying coordinated silvicultural prescriptions. Specific examples of these key areas and their needs are:

- o Calving Areas, including a 2-sight-distance hiding cover buffer between management activity and abrupt timber ecotones.

- o Crucial Winter Range, especially ridgetops, isolated bedding trees, south slopes, and thermal cover on the top third of north-facing slopes. Maintaining cover on this type of range is especially important where cover consists of long, narrow, north-facing timbered stringers and patches, less than one-fourth mile across. It is also important in areas adjacent to elk emergency feeding grounds.

- o Breeding Area Complexes, including a 2-sight-distance buffer around each. Also included are areas of habitual use that contain high densities of "rub trees."

- o Moist Areas, such as meadows, including a 2-sight-distance buffer of hiding cover on all sides.

- o Seasonal Migration Routes, including at least a 4-sight-distance buffer of hiding cover on each side of the migration route. This is especially important on ridgetops and saddles.

- o Daily Travel Lanes, including at least a 2-sight-distance buffer of hiding cover on each side of the lane.

b. In land management planning as well as in short-term and project planning, land managers should consider providing security areas scattered throughout the general area. (Refer to Figure 2 for relationships between road densities and security needs of elk.)

B. ROADS

The adverse effects of roads on elk populations and habitat are well documented in scientific literature. Peek (1979) divided the problem into two sets of factors: (1) physical factors--activities associated with the physical presence of a roadbed being a barrier, or a direct loss of elk habitat; and (2) activity factors--the disturbing effects of human activities that occur on and emanate from the road. Both physical and activity factors decrease elk use of otherwise suitable habitat.

The Idaho Fish and Game Commission recognized (1978) these problems officially by stating in the "Policy" section of its Goals, Objectives, and Policies, 1975-1990:

> It is recognized that additional road access into big-game areas is no longer desirable, and in some areas, the amount of roading is already detrimental to big-game habitat and hunting. Construction of additional permanent roads into big-game areas will be opposed and physical and/or legal closures of all existing and future unnecessary roads within these areas on U.S. Forest Service, Bureau of Land Management, and State of Idaho lands will be advocated and supported.

1. Physical Factors

Little factual information is available about the detrimental effects of roads obstructing the movements of elk. However, indications are strong that road cuts and fills, under certain circumstances, may actually become barriers to both daily and seasonal movements of elk within an area. Carrier et al., (1977) reported that road cuts more than 8 feet (2.4 m) deep, with 3/4 to 1 or steeper back slopes, are barriers to elk movement. Furthermore, road construction by itself causes some loss of both forage and cover from accustomed habitat. The amount of such loss varies according to road type, placement, and type of habitat disturbed.

Recommendations

Recommendations to mitigate habitat impacts caused by road building include:

a. Where cut slopes exceed 8 feet (2.4 m), with 3/4 to 1 slope extending for a linear distance of at least 200 yards (183 m), elk access should be provided whenever possible at major trails and travelways (usually through saddles, on ridges, and in stream bottoms) not exceeding the natural slope gradient.

b. Road rights-of-way (i.e., bed, cut, and fill) should be revegetated with forage and/or trees, whichever is appropriate, as soon as possible after the intended use of the road is terminated. Forbs are highly recommended for seed mixes, particularly legumes.

2. Activity Factors

The major consideration in the roading of elk habitat is the increased human access provided. Thiessen (1976) states, "The substantial reduction of elk between 1960 and 1974 was probably caused by direct over-harvest of female elk. This was made possible by a combination of proliferating access to

unroaded elk sanctuaries, coupled with hunting seasons promoting high level opportunity."

Leege noted (1974) a decline in elk numbers in the Pete King Creek area due to increased access, which made elk more vulnerable to hunters.

Numerous researchers have found that human activities on a road disturb elk so that they generally avoid roadside environments. Will notes (1979) a statistically significant avoidance of traveled roads out to 3/4 mile (1.2 km) by tracking radio-collared elk on the Sawtooth National Forest.

Lyon (1979) stated, "Pellet counts conducted over an eight-year period confirmed that elk in western Montana tend to avoid habitat adjacent to open forest roads. The area avoided increases where the density of tree cover is low. Forest roads open to traffic cause available habitat to be less then fully effective." His findings showed that, "In the absence of trees, elk use was still increasing between 1.5 and 2.0 miles away from roads. With any crown canopy of less than 75 percent, use was virtually stabilized beyond 0.9 mile, and under very dense canopy, there was no consistent increase in use beyond 0.6 mile."

For further detailed information, see Hershey and Leege 1976; Perry and Overly 1976; and Ward 1976.

All of the studies demonstrate degrees of avoidance of open roads by elk. The difference between studies is the amount of area affected, which directly relates to the openness of the habitat. From these data, the authors feel the disturbing effects of roads in central Idaho extends outward to at least one-half mile, as supported by Will's (1979) study. The reduction in use is shown in Table 1, page 19.

Recommendations

a. Loss of habitat resulting from disturbance activities from roads can be reduced by:

- o Locating roads as far away from key habitat components as possible.
- o Locating roads in timbered habitats when cover is not a limiting factor and keep clearing of right-of-way to a minimum.
- o Providing hiding cover patches of at least 2 sight distances along all roads that are to be left open.
- o Providing for closure or obliteration of all roads after their intended temporary use is terminated; if a road is to remain open, seasonal closure should be considered.
- o Planning the roading of drainages by anticipating orderly closure or obliteration of roads after their intended uses have terminated, laying out roads to facilitate closure, and considering the need for security areas.
- o Providing cattleguards with necessary drift fencing on new roads where objectives are to prevent livestock pressure on previously ungrazed habitats.

TABLE 1. Reduction in percent of elk use from activity on roads within one-half mile of existing roads for various types of road and of forest cover. 1/

(From Elk Habitat Coordinating Guidelines for Northern Idaho.)

Road Type 2/	Forest Cover 3/		
	Dense	Open	Clearing
Main road	30 (.7)	50 (.5)	70 (.3)
Secondary road	20 (.8)	35 (.65)	50 (.5)
Primitive road	10 (.9)	20 (.8)	30 (.7)

1/ Estimates derived from data reported by Perry and Overly (1976), Hershey and Leege (1976), Lyon (1979) and Will (1979).

2/ Main road is improved, has constant maintenance, and is a main travel route; secondary road is somewhat improved, but has only irregular maintenance; primitive road is unimproved and seldom or never maintained. Roads that are effectively closed to public motor traffic during periods of elk use are not considered in these calculations.

3/ Dense forest qualifies as hiding cover; open forest is not dense enough for hiding cover, but conifers do offer some cover value; clearings include meadows, clearcuts, seedtree cuts, etc.

( ) = Usability factor.

C. GRAZING

The compatability of elk and cattle is related to the interactions of several factors: (1) time and intensity of grazing (forage availability), and (2) social intolerance of cattle by elk (competition for space).

1. Forage Availability and Social Intolerance

Elk and cattle have similar preferences for forage and eat many of the same plants (Edgerton and Smith 1971: Stark 1973; Ward 1973; Krueger and Winward 1974; Ward et al., 1975: Hansen and Reid 1975; Nelson and Burnell 1975; Lonner 1978; and Wittinger 1978). Both prefer grasses on most ranges, and both may exhibit some seasonal selection for forbs. See Appendix (Tables 3 and 5) for local information about elk diets.

Probability of competition from livestock increases during periods when less forage is available and may be particularly accute (1) on key summer areas during periods of drought when forb growth is reduced and elk eat grass extensively; (2) when elk winter ranges receive moderate to heavy cattle (or cattle and elk) use during summer; and (3) on spring ranges when plants are drawing on their stored reserves and may be seriously damaged by continuous grazing (Mackie 1970; Ward 1973; Anderson and Scherzinger 1975; and Ward et al., 1975).

Elk prefer areas that have received little if any prior use by livestock within the same year and move extensively in response to changes in availability of forage and distribution and density of livestock. The extent of actual conflict depends upon the relationship of the number of animals and the carrying capacity of the range. (See Skovlin et al., 1968; Mackie 1970; Stark 1973; Ward 1973; Picton 1976; Burbridge and Neff 1976; Komberec 1976; Lonner 1978; Gruell et al., 1978.)

A 10-year study in northeastern Oregon indicated there was no evidence of direct competition between elk and cattle for forage volume, or any particular food plants on the study area. There was little simultaneous use by elk and cattle on the range. However, they found decreased elk use associated with increased cattle grazing. These data are summarized in Figure 3, page 21, which is used later in the "Application" section. Big-game preference was more closely related to number of plants grazed than to weights of forage removed (Skovlin et al., 1968).

Others have also shown that elk use decreased significantly as quantities of cattle-grazed plants increased - even when low levels of forage have been removed (Hurd and Kissinger 1953; Springfield and Peterson 1964; and Hudson et al., 1976). At the same time, elk prefer plants that have developed under-grazed (elk or livestock) rather than ungrazed conditions because they are higher in protein and more succulent.

Elk prefer deferred or rest systems over season-long on most ranges receiving moderate to heavy grazing (Skovlin et al., 1968; Wittinger 1978).

Lonner (1975b) presented data from Montana that strongly indicated negative interaction between elk and cattle (reflected by both pellet counts and ocular

PRODUCTIVITY TABLE

OPEN RANGE TYPE
Major Species:
- Bluebunch Wheatgrass[2]
- Onespike Danthonia
- Sandberg's Bluegrass
- Idaho Fescue
- June Grass
- Letherman's Needle & Thread Grass

Average Site Productivity 300-400#/Ac.

FORESTED RANGE
Major Species:
- Elk Sedge[1]
- Pine Grass[1]
- Idaho Fescue
- June Grass

Average Site Productivity 100-250#/Ac.

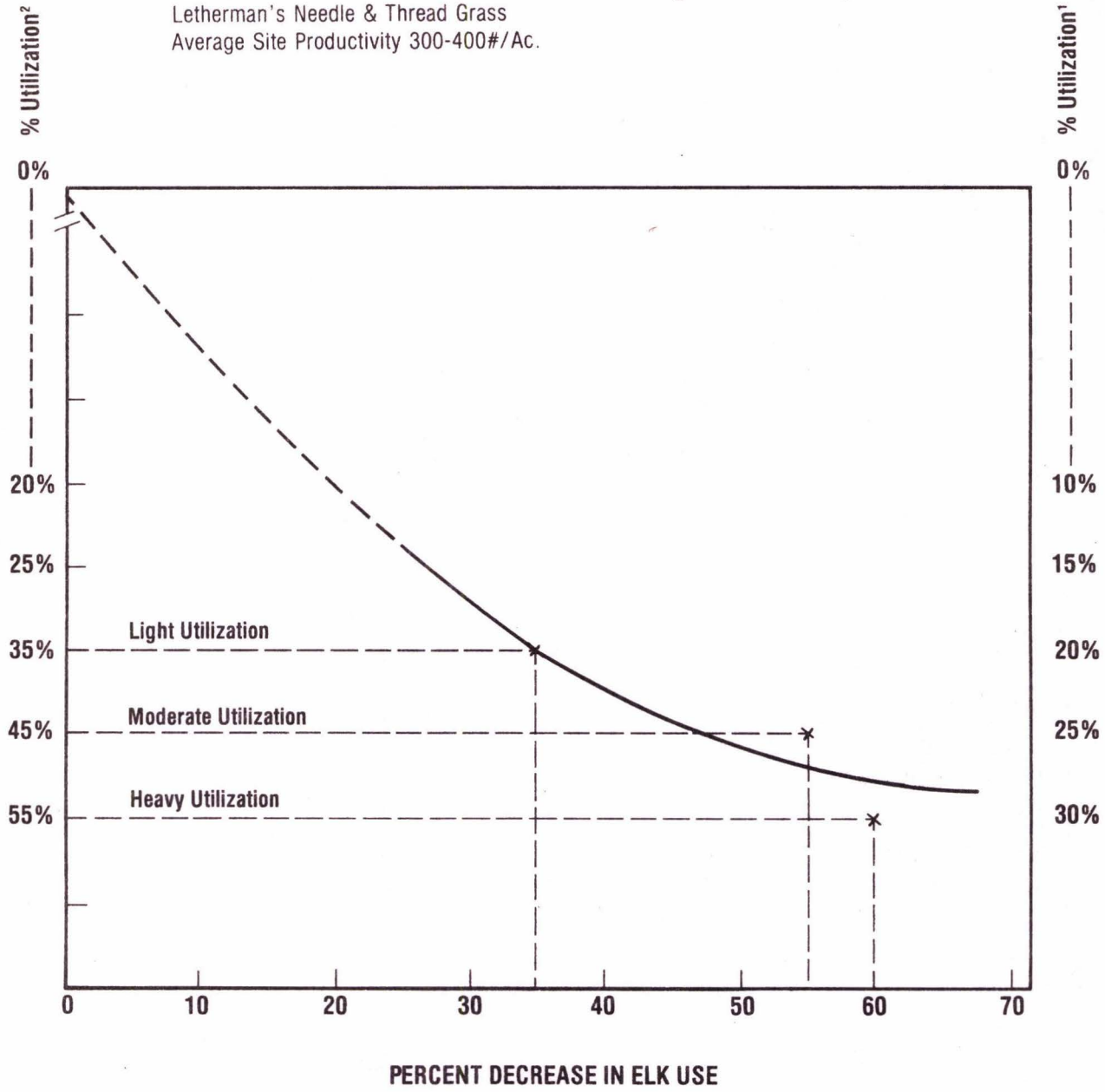


FIGURE 3. Relationship between cattle-elk use on a Ponderosa Pine-Bunchgrass range with a deferred rotation two-pasture grazing system. (Skovlin et al. 1968 & 1976.)

estimation of forage use). This negative interaction resulted in a displacement of elk by cattle that appeared to have been caused initially by social intolerance of elk toward cattle. He stated that, "Cattle distribution did not appear to be influenced by the presence of elk" (Lonner 1975b:72).

Stevens (1966) and Mackie (1970) both found that elk movement in Montana was influenced by the presence of cattle.

Nelson and Burnell (1976) concluded from studies in Washington that cattle impact on elk took the form of social interaction; elk left the immediate vicinity when cattle were introduced, many moving from the management unit. After cattle were removed, elk were not observed to use the management unit except for areas within the unit that were ungrazed by cattle.

The Gros Ventre Cooperative Elk Logging Study on the Bridger-Teton National Forest, using time lapse photography, demonstrated that elk abandon preferred summer range within just a few days after cattle enter the area, regardless of the amount of food plants remaining (Gruell et al., 1977 - Progress Report).

Most of the existing research and local experience supports the contention that social intolerance of elk toward cattle can significantly affect elk distribution and forage use on summer ranges; the authors and the Idaho Department of Fish and Game agree.

On the other hand, Ward et al., (1973) and Ward (1973a) reported no discernible incompatibility between elk and cattle, with light stocking levels, in summer range studies in south-central Wyoming.

2. Key Habitats

In central Idaho, there are two key habitats affected by livestock that may be limiting herd productivity.

Wildlife and range specialists generally concur that on summer/fall ranges, both cattle and elk seek out wet meadow/park areas for feeding and watering, surrounded by dense, cool forest of gentle slope for bedding and security areas.

Because of the dry conditions found in the east-central Idaho mountains, these wet areas make up only a very small part (approximately 2 percent) of the overall habitat. Most of these areas contain a relatively small number of AUM's and consist of much higher quality habitat than the surrounding dryer sites.

The authors and Idaho Department of Fish and Game feel that when an elk herd is displaced from this key summer habitat to surrounding steeper, dryer habitats, elk conditions and/or productivity may be reduced, especially where use is already occurring on adjacent areas.

The second limiting habitat is winter range. This is especially true in south-central Idaho. These areas are limited to valley bottoms and wind-blown

ridges. Again, there is agreement that these use sites are extremely important, and through grazing practices, forage should be provided for wintering elk. Where wintering habitats for elk are supplemented by hay and where they are very restrictive by nature of terrain, open slope availability, etc., these areas are the combating factor for herd productivity.

Recommendations

In the allotment planning process:

a. Through an interdisciplinary team approach, in coordination with the Idaho Department of Fish and Game, identify goals and objectives for managing elk habitat. Where management objectives are to maintain or enhance elk herd productivity, consider:

- o Scheduling grazing use to avoid conflicts on key habitats.
- o Designing grazing systems to provide a balanced portion of each key habitat in as many units as possible.
- o Providing grazing system flexibility to handle stress situations (i.e., drought problems, dual seasonal use on key habitats, etc.).
- o Coordinating rotation systems (pastures) and habitat management between adjacent allotments and other ownership lands so that suitable habitat is always available to elk.
- o Providing rest pastures. Four pasture systems are preferred over three pasture systems, especially when woody riparian vegetation is to be improved.
- o Excluding cattle from key habitat areas where other options are not feasible.

Additional items to consider in objective formulation are:

- o Increasing elk forage production, quality, and changing forage type through habitat manipulation, more intensive grazing systems, etc.
- o Managing livestock to enhance palatability and nutrient value of elk forage.
- o Coordinating range structural improvements with elk habitat needs.

b. Allotment planning should consider pertinent elk habitat needs or influences beyond existing allotment boundaries and grazing systems.

c. Establish monitoring programs to evaluate the grazing system and the accomplishment of planned objectives.

d. Identify areas where additional data are needed. Define how these data will be collected and how they will be used for evaluation/revision of the allotment management plan.

Note that items 3 and 4 need to be projected into the workforce and budget planning process.

3. Elk Mobility

Elk, especially calves, often have difficulty crossing fences when wire heights, slope, and surface characteristics (snow, talus, logging slash, rock) combine to create a hazardous barrier. During severe winters, elk on winter ranges may be physically weak; this adds to the hazards of maneuvering fences (Anderson 1980).

Recommendations

a. Construct all fences so the top wire or rail is not more than 42 inches (1.07 m) above ground, and the bottom wire or rail is at least 18 inches (0.4 m) above ground. Use smooth wire on top wherever possible and limit the number of strands.

b. Where possible, use log or pole fences.

c. Locate sidehill fences on slopes less than 30 percent, especially where footing is bad.

d. Where elk traffic is heavy, consider let-down sections, gates, or lower fences, especially where minimal livestock pressure on fences can be determined.

e. Consider use of "Rider" pole(s) on wire fences where crossings occur.

D. OFF-ROAD VEHICLES

Off-road vehicles can adversely affect both elk and their habitat. Adverse effects on the animal range from accelerated heartbeat caused by noise from vehicles to total abandonment of important habitat areas because of harassment.

Studies indicate that effects of off-road vehicles on elk differ on the basis of behavioral patterns and learned responses developed in various habitat conditions and at various seasons of the year.

Studies of elk behavior in relation to multiple uses on the Medicine Bow National Forest (Ward 1973) showed that elk preferred to be at least one-half mile (0.8 km) from human activities. Off-road vehicles (trailbikes, snow machines, and other all-terrain vehicles) that bring concentrations of people within one-half mile of calving, breeding, migrating, wintering, or important foraging areas disrupt habitual elk behavior.

Coggins and Zobell (1972) found that use of all-terrain vehicles, cross-country trail machines, and snowmobiles increased the legal harvest and illegal kill of elk. The same study also reported an adverse effect upon the survival of trophy elk resulting from the increased hunter access provided by these vehicles.

Other studies indicate elk react less to constant, continuous vehicular movement than to periodic slow vehicle use, especially when vehicles stop and human activity follows. This is characteristic of off-road vehicle movement (Burbridge and Neff 1976; Ward 1976). Elk are extremely susceptible to disturbance by off-road vehicles in winter when they are confined to small areas and are in poor condition. Snowmobiles have created serious problems during the winter by changing the distribution of wintering elk herds. Mortality may occur when elk are harassed by off-road vehicles in critical seasons such as winter, the breeding season, and calving time (Geist 1971).

Also of particular concern is the damage by off-road vehicles to identified key habitats. Motorbikes have destroyed elk forage in high cirque basins, meadows, and moist areas.

Recommendations

a. When planning for ORV use, consider:

- o Informing and educating the public and especially ORV users to the effects of unrestricted ORV use on elk and involve them in the planning process.
- o Avoiding key wildlife habitats.
- o Providing adequate enforcement for travel closures.

b. Consider closing areas surrounding key habitat components to ORV use whenever elk are present or when conflict of occupancy is anticipated.

c. Close key elk summer or winter range to all entry by off-road vehicles where forage is being destroyed.

APPLICATION

Predicting Elk Responses to Habitat Changes and Disturbance Factors

Cover:Forage Ratios

Wildlife biologists in central Idaho concur that on spring-summer-fall habitats, cover (both hiding and thermal) is more often an important component of elk habitat than forage because it is more frequently lacking. However, many habitats containing over 40 percent cover can be improved to some degree through logging. This relationship is demonstrated by the habitat groups (curve types) in Figure 4, page 27, and Table 4 in Appendix, page 43.

Some habitat types (Type I curve) are especially important as summer range because of their high water table, cool temperatures, and the succulent vegetation they produce. These habitats usually occur in limited amounts, such as in creek bottoms, cirque basins, benches, and near lakes and bogs. Maximum elk use is assumed to occur in these areas when the cover:forage ratio is 75:25. Removal of canopy down to 75 percent will improve these habitats, but additional removal decreases the attributes elk seek there during the hottest part of the year.

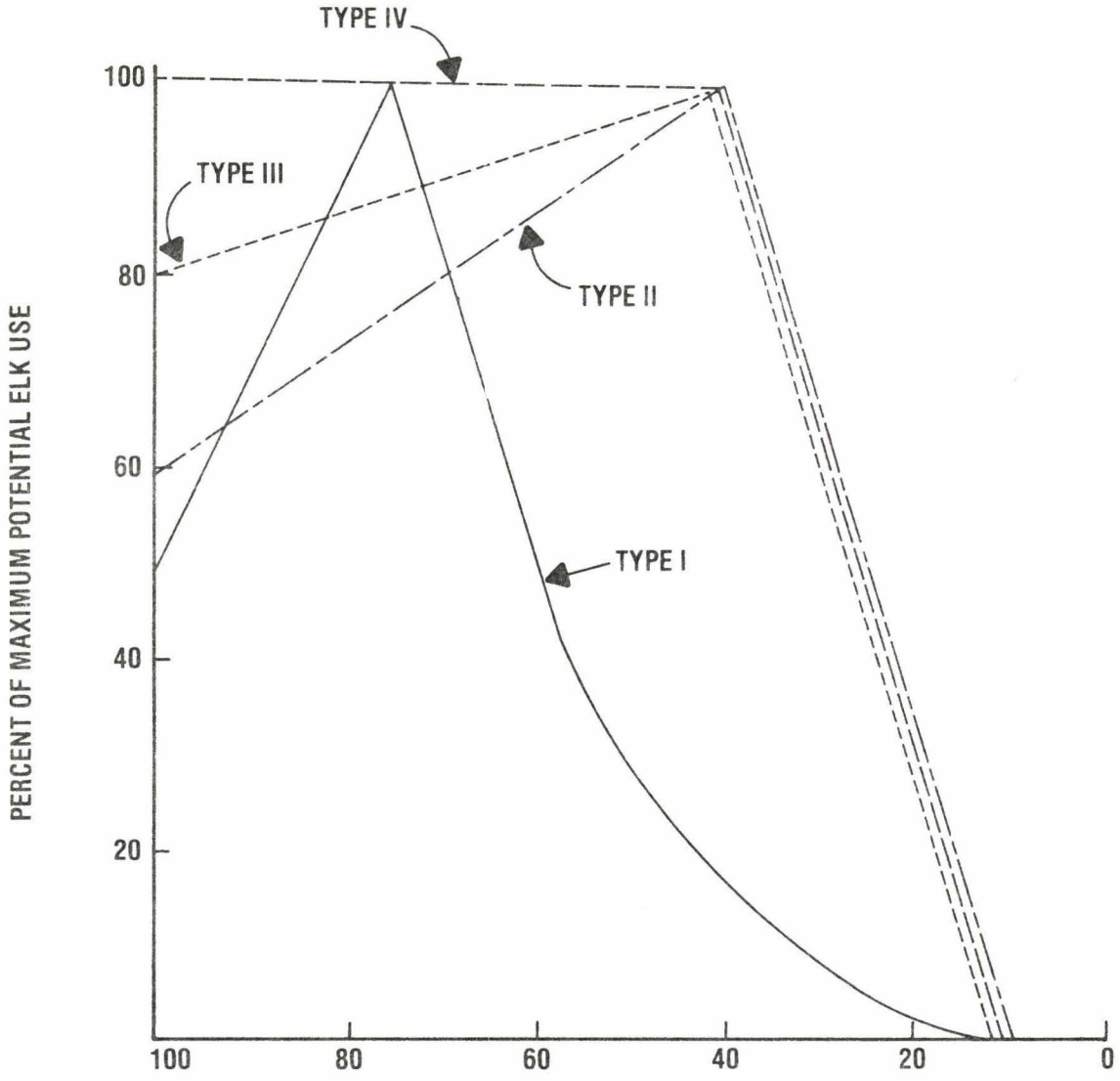
Other habitat types (Type II curve) mainly provide hiding cover and can produce moderate thermal cover on spring-summer-fall range. They produce large volumes of forage in the early successional stages. The best opportunities for improving elk habitat may be in Type II habitats.

The third group of habitats (Type III curve) produce low to moderate hiding cover, but very little thermal cover. Most of these habitats are at high elevation and are low productivity sites that cannot produce much forage.

Curve Type IV habitats occur primarily at lower or higher elevations where summer use by elk is usually light because of lack of thermal cover and/or inherently poor forage production. Elk commonly use low elevation habitats during winter and early spring; hence, any proposed logging here should be evaluated in light of elk needs at those seasons. In some locations, it will be necessary to establish season of use by ground surveys before logging or other activities can be properly planned.

On winter range, cover, particularly thermal cover, may be even more important than on summer range. Opportunity to produce additional forage on winter range through timber harvest is very limited and, if attempted, will usually be achieved at the expense of cover. This will require that each project be carefully evaluated to determine which component is needed more.

The stringer and patchy nature of timber on winter range provides very limited opportunity to create additional thermal cover. Each winter range must be evaluated on its own merits; the natural potential cover probably is the best attainable for the site. To meet thermal cover needs of elk on winter ranges, the objective should be to remove only trees that provide no cover or to create larger average tree size within the stand.



(Habitat types forming each curve are identified in Table 4, pages 47-49 and described on page .)

FIGURE 4. Percent of maximum potential elk use, based on needs for cover, of four habitat groups (Curve types I, II, III, IV). Curve types were developed by Central Idaho biologists on the basis of their general knowledge of elk behavior and pertinent literature on the subject.

Roads

Optimum habitat consists of a desirable distribution of cover and forage, and more importantly, a locale where elk are not being displaced by man's activities. When human intrusions are frequent, an elk's need for cover increases greatly. Because roads introduce most man-associated disturbances onto elk ranges, we have adopted the method of predicting effects of roads on elk use of habitat from Elk Habitat Coordinating Guidelines for Northern Idaho (Carrier et al., 1977). In these calculations, roads are considered as nonexistent if they are gated during the normal period elk would be in the area. If roads are treated this way in the computations, it is important that closure be effective and that all motorized use be prevented, except for infrequent administrative use.

Adjacent Areas

An area proposed for a timber sale or other activity, cannot be properly evaluated for elk use without considering the surrounding habitat, the optimum cover:forage ratios, grazing, access roads in areas on all sides of it, etc. For example, a 100-acre (40.5 ha) patch of standing timber is more important as hiding or thermal cover or both if the surrounding 500 acres (202.4 ha) have been recently clearcut than if similar timber remains on all sides. Similarly, when evaluating an entire home range, it is important that the land manager consider elk habitat suitability and effects on elk use in adjacent areas (home ranges) so that the significance of proposed activities can be properly determined.

Computations of Changes in Potential Elk Use

Specific care should be taken in evaluation and comparison of the potential effects of land use activities, that the following process does not preclude or over-shadow subjective decisionmaking processes. It is intended to be used as a complimentary evaluation process to appropriate interdisciplinary reviews.

Carrier et al., (1977) developed a computation system to aid in assessment of present and proposed land use practices on elk habitat and to provide a uniform means of displaying the pertinent data. This system provides the land manager with a sequential method in which to array the factor(s) (logging, livestock, roading, mining, ratio, and distribution of hiding and thermal cover, mining, etc.) and their relative effects on elk use in a specific land area.

A study in central Idaho has determined the average summer-fall home range for a cow elk to be about 4,000 acres (1,619 ha) (Will 1979). This should be the minimum size for evaluation of elk habitat and should be expanded when a timber sale, cattle allotment, road proposal, etc., is larger than 4,000 acres or when physical and biological components of the environment suggest more suitable boundaries for the home range. When a 4,000 acre home range is to be increased, a wildlife biologist should be consulted for determining the exact size and location. Where a 4,000 acre circle seems adequate, the circle is drawn with a radius of 1.41 miles (2.27 km) around what is determined to be the center of the activities. Winter range should not be included, but 4,000

acres within spring-summer-fall range should. Winter range should be evaluated separately, using recommendations for key habitats identified in previous sections.

Another judgment situation occurs in areas where timber is growing in stringers and patches. In this case, where the home range boundary is drawn may be critical in the computation of cover:forage ratios and should be based on elk habits in the region, elk numbers, and knowledge of current elk use in the area.

Procedure

The first step in estimating effects of a proposed timber sale or other activity is to plot their boundaries on an aerial photograph or map that shows past, present, and projected management activities.

Pages 30, 31, and 32 are typical completed evaluation forms. Form 1 records pre-activity evaluations, and Form 2 shows estimated post-activity changes in potential elk use under various alternatives.

Figures 5 and 6 show the existing conditions and conditions after all activities have taken place. In this example, on the 4,000-acre home range, there will be timber harvesting in five partial cutting units in four habitat types. In addition, there will also be a change in livestock use; from a two pasture deferred-rotation system to a four pasture rest-rotation system (not shown). An additional 3.4 miles of road will be constructed into the area, which will remain open for vehicular traffic during the spring-summer-fall months.

Computing Change in Elk Use Caused by Alteration of Cover

To compute changes, follow the step-by-step procedure outlined below, entering calculations on Form 1:

1. Measure the usable acres of elk habitat in a home range (A).

2. Measure the acres that qualify as hiding and thermal cover (B).

3. Calculate percent of acres usable as cover (C) by dividing acres in cover by acres of home range (i.e., 2,350 ÷ 4,000 = 59%).

4. Using Table 4, list the habitat type(s) with the appropriate Curve Type (habitat group). Then determine usable acres in each habitat group (D) (i.e., 50 acres in Type I, 1,800 acres in Type III, and 500 acres in Type IV).

5. The summation of these figures is E.

6. For each habitat type group, determine what percent it comprises of the total acres in cover by dividing the acres in any habitat type group (D) by the acres in cover (E) (ie., Type I = 50 ÷ 2,350 = 2%).

FORM 1

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL

Area: Black Bear Cr.
Alternative: Pre-activity
Calculated by: Leege
Date: 5-17-79

1. Change in potential elk use because of alteration in cover.

Total usable acres in home range* 4,000 (A)

Total acres in hiding and thermal cover 2,350 (B)

Percent of usable acres in cover (B)÷(A) 59 (C)

Forest habitat type	Curve type (Table 4 appendix)	Total usable acres in habitat type (group) (D)	Percent of all acres (D)÷(E) (F)	Percent of maximum potential elk use (use (C) and Fig. 4) (G)	Weighted use factor (F)X(G) (H)	Weighted percent max. potential elk use (I)÷100 (J)	Percent below max. potential elk use (100)-(J) (K)
Abla/Caca	I	50	2	45	90		
	II						
Abla/Vasc Psme/Caru	III	1800	77	93	7161		
Psme/Feid	IV	500	21	100	2100		
TOTALS		2350 (E)	100		9351 (I)	94 %	-6 %

2. Change in potential elk use because of roads.

Total usable acres more than one-half mile away from open road 2340 (L)

Total acres affected by roads (A)-(L) 1660 (M)

Acres affected by each type of road in each vegetation type:

Road type[1]	Vegetation type[1]	Miles (N)	Proportion of total (N)÷(B) (P)[2]	Acres	(R)	Acres usable at 100% (Q)X(R) (S)
Main	Dense forest				.7	
	Open forest				.5	
	Clearing				.3	
Secondary	Dense forest				.8	
	Open forest				.65	
	Clearing	2.6	1.0	1660	.5	830
Primitive	Dense forest				.9	
	Open forest				.8	
	Clearing				.7	
	TOTALS	2.6 (B)	1.0		TOTAL	830 (T)

Example

Disturbed acres on both sides of all open roads (B)X(640) 1664 (U)

Factor indicating overlap of road disturbance zones (M)÷(U) .998 (V)

Acres in road disturbance zone usable at 100% (T)X(V) 828 (W)

Total acres within home range usable at 100% (L)+(W) 3168 (a)

Percent of home range usable at 100% (a)÷(A) 79 (b)

Change in potential elk use on home range because of road influences (100)-(b) 21 (X)

* Non-use areas: talus, water surface, and other areas elk would not use because of natural features.

[1] Refer to footnotes in Table 1, p. 19, for definitions of road and vegetation types.

[2] These figures derived from Table 1, p. 19

FORM 2

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL (Continued)

Area: Black Bear Cr.
Calculated by: Leege
Date: May 17, 1979

Alternative A

Pasture	(a) Suitable Grazing Acres	(c) Actual or expected use rate in % Year 1	2	3	4	5	6	(d) Weighted use factor for each yr. (a×c) Year 1	2	3	4	5	6	(f) Average % use factor for each year (e÷b) Year 1	2	3	4	5	6
A	650	.40	.50					260	325					46	51				
B	850	.50	.40					425	340										
TOTALS	(b) 1500							(e) 685	765					49	.58				

(g) % reduction in elk use for each year from Figure 3 — Year 1 | 2 | 3 | 4 | 5 | 6

(h) Total of (g) for all years: 107

(i) Average reduction in elk use during the rotation cycle (h÷no. yrs/cycle) = 54

(j) Average for entire home range $\frac{(b)x(i)}{\text{No. of acres in home range}}$ = 20%

4. Change in potential elk use because of other factors (see Table 2, p. 38.)

	Natural[1]	Pre-Activity	Alt. A		
Size and interspersion of forage areas	-5	-5	-5		
Ratio, size, and distribution of hiding cover, and travel lanes	-5	-5	-5		
Adequacy of security areas	0	0	0		
Level of forage competing areas	0	0	-2		
TOTAL change in factors (Z)	-10	-10	-12		

Example

5. Summary of predicted changes in maximum potential use.

	Natural[1]	Habitat Effectiveness	Pre-Activity	Habitat Effectiveness	Post-Activity Alternative A	Habitat Effectiveness
Maximum potential elk use of home range	100%		100%		100%	
Cover: forage ratios	69:30		59:41		51:48	
Change from suboptimal cover (K)	-10	.90	-6	.94	-4	.96
Change from road influences (X)	0		-21	.79	-40	.60
Change from livestock influences (j)	0		-20	.80	-17	.83
Change from other factors (Z)	-10	.90	-10	.90	-12	.88
Percent of maximum potential elk use		81%		53%		42%
Change in potential elk use from pre-activity situation					-11%	

[1] Condition prior to any activity.

FORM 2

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL (Continued)

Area: Black Bear Cr.
Calculated by: Leege
Date: May 17, 1979

Alternative A

Pasture	(a) Suitable Grazing Acres	(c) Actual or expected use rate in % Year 1	2	3	4	5	6	(d) Weighted use factor for each yr. (a x c) Year 1	2	3	4	5	6	(f) Average % use factor for each year (e ÷ b) Year 1	2	3	4	5	6
A	650	.60	.70	0	.60			390	455	0	390			.52	.56	.30	.26		
B	850	.60	.60	.70	0			390	390	455	0								
														1	2	3	4	5	6
TOTALS	(b) 1500							(e) 780	845	455	390			.58	.62	.31	.27		

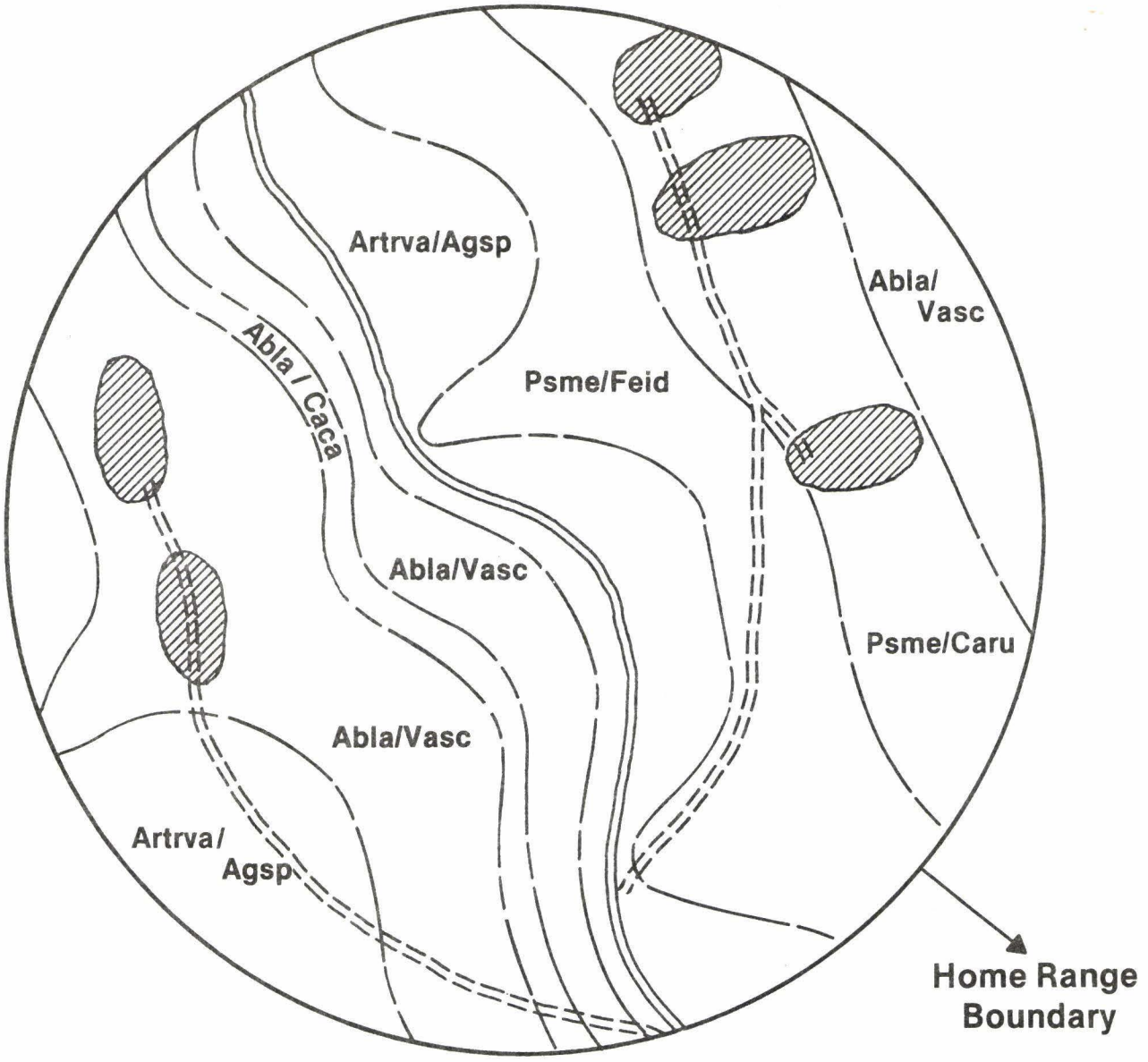
(g) % reduction in elk use for each year from Figure 3

(h) Total of (g) for all years: 178

(i) Average reduction in elk use during the rotation cycle (h ÷ no. yrs/cycle) = .45

(j) Average for entire home range $\frac{(b) \times (i)}{\text{No. of acres in home range}}$ = 17%

Example

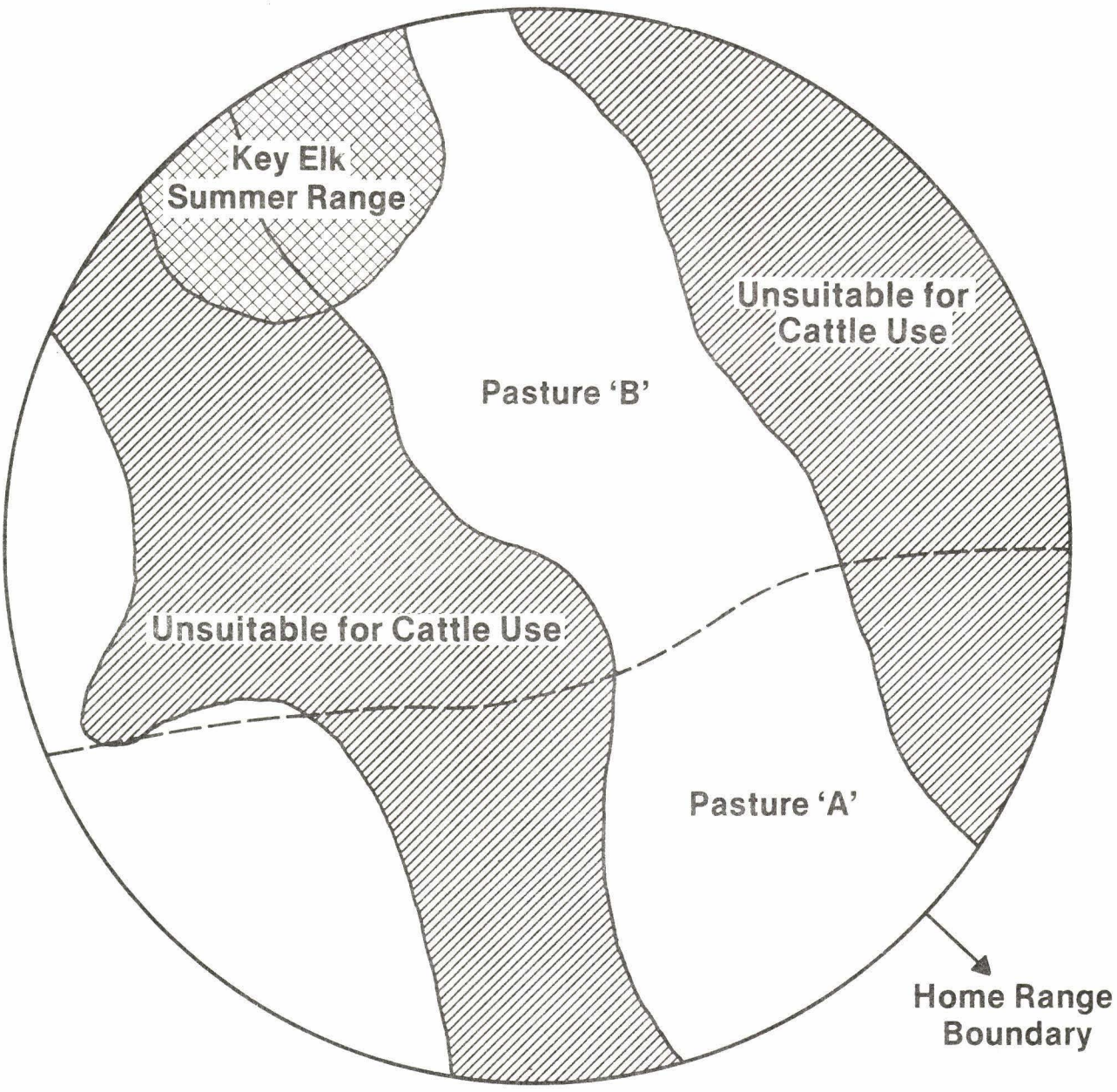


SALE LAYOUT SCHEMATIC

Scale: 1" = 2483 ft. (757 M)
1 Sq. Inch = 143 Acres (58 ha)

Habitat Type Boundaries
Secondary Roads Already Present
Secondary Roads to be Constructed for Sale
Areas Proposed for Timber Harvesting

FIGURE 5. Schematic of sale layout within Black Bear Creek home range.



CATTLE / ELK USE SCHEMATIC

Scale: 1" = 2483 Ft. (757 M)
1 Sq. Inch = 143 Acres (57.9 ha)

Key Wildlife Areas

Pasture Boundary

Unsuitable for Cattle/Elk Use

FIGURE 6. Schematic of cattle-elk use within Black Bear Creek home range.

7. The percent of maximum potential elk use (G) is determined by using (C) and reading directly from Figure 4 (i.e., Type I = 45%, Type II = 93%, and Type IV = 100%).

8. Determine the weighted factor (H) for each habitat type group by multiplying the percent of all acres (F) by the percent of maximum potential elk use (G) (i.e., Type I = 2 x 45 = 90).

9. The total weighted use factor (I) is determined by adding each of the individual weighted use factors (H) (i.e., 90 + 7161 + 2100 = 9351).

10. Determine weighted percent maximum potential elk use (J) by dividing the total weighted use factor (I) by 100 (i.e., 9351 ÷ 100 = 94%).

11. Subtract weighted percent maximum potential elk use (J) from 100 to get the percent below maximum potential elk use (i.e., 100 - 94 = 6%).

12. Repeat the procedure for post-sale activities, entering results on the second Form I and Summary Form 2.

Computing Change in Elk Use Because of Roads

To compute changes, follow the step-by-step procedure outlined below, entering calculations on Form 1:

1. Measure the usable acres of habitat that are more than one-half mile from an open road (L), excluding roads that are effectively closed to motorized vehicles during the period elk would normally occupy the area.

2. Subtract areas over one-half mile from a road (L) from the total usable acres (A) to determine the total acres affected by roads (M) (i.e., 4000 - 2340 = 1660).

3. Determine the miles of each type of road by vegetation type (N), adding the N values to give a total (O).

4. Determine what proportion each road type is of the total (P) by dividing the miles of road in each class (N) by the total miles (O) (i.e., 2.6 ÷ 2.6 = 1.0).

5. Determine the acres affected in each road class (O) by multiplying the total acres affected by roads (M) by the proportion of the total in each class (P).

6. Calculate the acres usable at 100 percent (S) by multiplying the acres affected (Q) by the usability factor (R), which is the percent of the acreage within one-half mile of a road that we can expect to be used by elk at 100 percent of potential; the remaining acreage in the half-mile zone will be used as 0 percent (i.e., 1660 x .5 = 830).

7. Add (S) values to give the total acres usable at 100 percent (T).

8. Calculate the disturbed areas on both sides of the road (U) by multiplying the total miles of road (O) by 640 acres (i.e., 2.6 x 640 = 1664).

9. Calculate the overlap factor (V) that adjusts the overlap of disturbance zones where roads are closer than one mile apart by dividing the total acres affected (M) by disturbed acres (U) (i.e., 1660 ÷ 1664 = .998).

10. Calculate the acres in road disturbance zone usable at 100 percent (W) by multiplying the total acres at 100 percent (T) by the overlap factor (V) (i.e., 830 x .998 = 828).

11. Add the total usable acres more than one-half mile from road (L) to the acres in road disturbance zone usable at 100 percent (W) to determine the total acres within the home range usable at 100 percent (a) (i.e., 2340 + 828 = 3168).

12. Percent of home range usable at 100 percent (b) is determined by dividing (a) by the total usable acres in home range (A) (i.e., 3168 ÷ 4000 = 79%).

13. Subtracting the percentage of home range usable at 100 percent (b) from 100 percent produces a change in potential elk use because of road influences (X) (i.e., 100 - 79 = 21%).

14. Repeat the procedure for post-sale activities, entering results on the second Form 1 and Summary Form 2.

Computing Change in Elk Use Because of Cattle Grazing

To compute changes, follow step-by-step procedures outlined below, entering calculations on Form 2:

1. Calculate the acres of suitable livestock range within each pasture (a) and the total acres (b) of the allotment that are included in the home range (i.e., 650 + 850 = 1500). Exclude elk non-use areas.

2. Determine the actual or expected cattle use rates (c) for each pasture through each year of the cycle (i.e., pasture A = 40% in year one (.4) and 50% in year two (.5).

3. Determine a weighted use factor (d) for each pasture by multiplying suitable grazing acres for each pasture (a) by actual or expected use rates (c) for each year. Adding the weighted use factors (d) for each pasture will give a total weighted use factor (e) (i.e., (650 x .4) + (850 x .5) = 685).

4. Determine an average use factor (f) by dividing the total weighted use factor (e) by total suitable grazing acres (b) for each year (i.e., 685 ÷ 1500 = 46%).

5. The percent reduction in elk use on suitable acres (g) is determined for each year by reading directly from the appropriate axis (open or forested range) on Figure 3. Total the figures (h) for each year and divide by the number of years per grazing cycle to give the average reduction in elk use (i) (i.e., (.49 + .58) ÷ 2 = 54%)

6. The average percent reduction in elk use for the entire home range (i) is determined by multiplying the total number of suitable grazing acres (h) by the average reduction in elk use (i) and dividing the product by the number of acres in the home range (i.e., (1500 x .54) ÷ 4000 = 14%).

7. Repeat the procedure for the change in livestock use, entering results on the back of Form 2. In this case, the two-pasture deferred system is joined with an adjacent area to form a four-pasture rest-rotation and, therefore, use rates change. Only pasture A and B fall within the Black Bear Creek home range.

Change in Elk Use Because of Other Factors--Pre-activity
(Form 2, Table 2, Page 38)

In the example, forage areas are adequately distributed over the home range since some occur in each of the four quadrants (for consistency, quadrant boundaries should be drawn at right angles, north-south and east-west). Therefore, there is no change in elk use. Some forage areas, however, are much wider than 1,200 feet (304.8 m); therefore, we subtract 5 percent from maximum potential elk use because of the little-used acreage in the middle part of the forage area (Table 2).

Cover areas, when checked, proved to have adequate hiding and thermal cover. However, the cover was not adequately distributed over the entire home range; it was clumped into three of the quadrants. Therefore, an arbitrary 5 percent was subtracted from maximum potential use.

Because of the large cover area, more than one-half mile (0.8 km) from an open road, security is adequate. Sagebrush/grass forage areas have a high level of forage production and are near optimum for the site; therefore, no change in elk use occurs for either of these parameters.

Deductions for these four factors add up to an additional 10 percent (Z) reduction in maximum potential elk use. In this case, pre-activity and natural conditions are the same since there were no prior activities significantly affecting size and interspersion of forage and cover.

Change in Elk Use Because of Other Factors -- Post-activity, Alternative A
(Form 2)

The sale would have little effect on the ratio, size, and distribution of forage areas or hiding and thermal cover. Therefore, the same percent of potential elk use is subtracted as under pre-activity conditions, 10 percent.

More than 20 percent of the home range would still qualify as security area; therefore, no deduction would be made. This analysis comes from looking at the areas delineated when determining (L) to see whether they are adequate in size (use Figure 2 as a guide). The overstory harvest will create slash that is to be lopped and scattered. The unnumbered table on page 15 shows that this is a poor method for creating and making elk forage available. When the new forage areas are averaged with the pre-activity or existing forage area, the resulting weighted average would be a bit less than optimal; so 2 percent is deducted.

TABLE 2. Other factors that reduce (by percentages) potential elk use on spring, summer, and fall range.

Factor	Percent Reduction
Size and Interspersion of Forage Areas	
Forage areas present in all quadrants All forage areas no wider than 1,200 feet At least 800 feet hiding or thermal cover between all forage areas	0
Forage areas present in three quadrants 50 percent of forage areas no wider than 1,200 feet At least 800 feet of cover between 50 percent of forage areas	5
Forage areas present in one or two quadrants All forage areas wider than 1,200 feet Less than 800 feet cover between forage areas	10
Ratio, Size, and Distribution of Hiding and Thermal Cover and Travel Lanes	
At least 40 percent of each quadrant is hiding and/or thermal cover At least 30 percent of each home range is in hiding cover and 15 percent in thermal cover Main travel lanes are maintained in cover 4 sight-distances wide	0
At least 30 percent of at least three quadrants is hiding and/or thermal cover 15 percent of home range is in hiding cover and 8 percent is thermal cover	15

TABLE 2. Continued

Factor	Percent Reduction
Main travel lanes are maintained in cover 2 sight distances wide	
Each cover type occurs in only one quadrant Less than 5 percent of home range is hiding cover and/or less than 2 percent is in thermal cover Travel lanes are not protected by cover	30
Adequacy of Security Area	
At least 20 percent of home range qualifies as security area	0
10 percent of home range qualifies as security area	25
Home range has no security area	50
Availability and Level of Forage Production in Feeding Areas	
Forage areas have average relative value index of 3 or more (see page 15)	0
Forage areas have average relative value index of less than 3 (see page 15)	10

These other factors produce a total post-activity reduction from maximum potential elk use of 12 percent (Z).

Summary of Predictable Changes in Maximum Potential Elk Use (Form 2)

This section summarizes potential elk use for natural, pre-activity, and post-activity conditions.

Pre-activity

A 6 percent reduction in elk use from the cover forage situation is 94 percent (100 - 6 = 94%) habitat effectiveness. A further reduction of 21 percent for road impacts is 79 percent habitat effectiveness; 20 percent reduction for livestock (80 percent habitat effectiveness) and 10 percent reduction for other factors (90 percent habitat effectiveness). Multiplying habitat effectiveness of all four individual factors produces a net habitat effectiveness of 53 percent (.94 x .79 x .80 x .90). Habitat effectiveness for natural conditions (prior to any activity) was 81 percent.

Post-activity

Elk use before the proposed activities was calculated to be 53 percent of maximum potential. This was reduced to 42 percent after the proposed activities, a reduction of 21 percent (11 - 53). *It should be remembered that these are not absolute values, but do show relations between degrees of impact when several alternatives are being evaluated.*

Analysis of Effect of Proposed Activities - Alternative A

By looking closely at factors that affect maximum potential use (Form 2), it is possible to devise ways of reducing detrimental effects of management activities. For example, if proposed roads in the home range were to be closed, potential elk use would increase by 19 percent. Logging has improved the cover:forage ratios so that potential elk use increased by 2 percent from pre-activity and 6 percent from natural conditions. By implementing a more intensive grazing system, potential elk use has increased by 9 percent on the pastures in the allotment and 3 percent over the entire home range. Elk use could be increased further by using silvicultural methods that produce better forage areas and by leaving at least 800 feet of cover between forage areas. By displaying the effects in this form, line officers can readily visualize tradeoffs, mitigation measures, and enhancement opportunities for elk.

APPENDIX

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TABLE 3. Plant type and species eaten by elk in the East Fork of Salmon River (Challis Volcanics) by year (1977-1979) and seasons, in percentages, as determined by analysis at feeding sites.*

Plant Type	Year	Spring	Summer	Fall	Winter
		Percent			
Grasses and sedges	1977	51	30	87	50
	1978	94	56	78	90
	1979	71	28	83	54
Forbs	1977	43	66	10	34
	1978	5	44	9	0
	1979	28	71	4	3
Shrubs	1977	6	4	3	16
	1978	1	0	12	10
	1979	0	2	12	43
Important species (in order of importance)		Bluebunch wheatgrass Bluegrass Sedge Idaho fescue Aster Dandelion Lupine Wildrye	Sedge Lupine Prairie junegrass Dandelion Bluegrass Aster	Bluegrass Idaho fescue Prairie junegrass Sedge Green rabbit-brush Lupine Bluebunch wheatgrass	Bluebunch wheatgrass Bluegrass Lupine Sedge Idaho fescue Green rabbit-brush

* Wittinger 1978; Yeo 1980

TABLE 4. Seasonal values 1/ of selected habitat types in central Idaho for cover, forage, and special uses.

Habitat Type		Hiding Cover				Thermal Cover				Forage				Special Uses		Cover Type 2/
		S	S	F	W	S	S	F	W	S	S	F	W	C	B	
Pinus ponderosa/Agropyron spicatum	L					(3)			3	4			5		(3)	IV
Ponderosa pine/Bluebunch wheatgrass	E									3			5			
Pinus ponderosa/Festuca idahoensis	L					3			3	3			4			IV
Ponderosa pine/Idaho fescue	E									3			4			
Pinus ponderosa/Purshia tridentata	L					3				3		3	4			III
Ponderosa pine/Antelope bitterbrush	E									3		3	4			
Pinus ponderosa/Symphoricarpos albus	L								3	3			4	(3)		III
Ponderosa pine/Common snowberry	E									3			4			
Pinus ponderosa/Symphoricarpos oreophilus	L					3			3	3			4			IV
Ponderosa pine/Mountain snowberry	E									3			4			
Pseudotsuga menziesii/Agropyron spicatum	L							3	3(5)	3		3	4		3	IV
Douglas-fir/Bluebunch wheatgrass	E									3		3	4			
Pseudotsuga menziesii/Festuca idahoensis	L							3	3	3		3	3			IV
Douglas-fir/Idaho fescue	E									3		3	3			
Pseudotsuga menziesii/Cercocarpus ledifolius	L			3				3	3			4	5			IV
Douglas-fir/Curl-leaf mtn. mahogany	E											4	5			
Pseudotsuga menziesii/Juniper communis	L		3	3	(4)		3	3	(4)							III
Douglas-fir/Common juniper	E															
Pseudotsuga menziesii/Arnica cordifolia	L		3	3			3	3								III
Douglas-fir/Heartleaf Arnica	E										3	3				
Pseudotsuga menziesii/Carex geyeri	L		3	3				3	3		3	3	3	3	3	III
Douglas-fir/Elk sedge	E										3	3	3			
Pseudotsuga menziesii/Calamagrostis rubescens	L	3	3	3	3	3	3	3	3(5)					(5)		III
Douglas-fir/Pinegrass	E										3	3				

1/ Values range from 3 (medium) to 5 (high)
2/ As shown in Figure 4

L = Late successional stages
E = Early successional stages

( ) = Locally different value; not the rule
S, S, F, W = Spring, Summer, Fall, Winter
C = Calving
B = Breeding

TABLE 4. Continued

Habitat Type		Hiding Cover				Thermal Cover				Forage				Special Uses		Cover Type 2/
		S	S	F	W	S	S	F	W	S	S	F	W	C	R	
Pseudotsuga menziesii/Spiraea betulifolia	L	3	3		3	3	3	3	3	3	3					II
Douglas fir/White spiraea	E									3	3	3	3			
Pseudotsuga menziesii/Symphoricarpos albus	L	3	3	3	3	3	3	3	3	3	3		(5)			II
Douglas fir/Common snowberry	E									4	4	3	3			
Pseudotsuga menziesii/Symphoricarpos oreophilus	L	3	3	3	3			3	3		3	3	3	(3)	(3)	III
Douglas fir/Mountain snowberry	E										3	3	3			
Pseudotsuga menziesii/Acer glabrum	L	3	3	3	(3)	3	3	3	(3)			3	(3)	(5)		II
Douglas fir/Mountain maple	E									3	3	3	(3)			
Pseudotsuga menziesii/Physocarpus malvaceus	L	3	3	3	3	3	3	4	5				3(5)			II
Douglas fir/Ninebark	E									4	4	4	4			
Pseudotsuga menziesii/Vaccinium globulare	L		4	4			3	3	(3)		3	3			4	II
Douglas fir/Blue huckleberry	E										4	4				
Pseudotsuga menziesii/Xerophyllum tenax	L		4	4			3	3							4	II
Douglas fir/Beargrass	E										4	4				
Abies lasiocarpa/Arnica cordifolia	L		3	3			3	3								III
Subalpine fir/Heatleaf arnica	E															
Abies lasiocarpa/Juniperus communis	L		3	3			3	3								III
Subalpine fir/Common juniper	E															
Abies lasiocarpa/Carex geyeri	L	3	3	3		3	3	3			3	4		4	3	III
Subalpine fir/Elk sedge	E										3	4				
Abies lasiocarpa/Calamagrostis canadensis	L		3	3			3	3								III
Subalpine fir/Bluejoint	E										3	3				
Abies lasiocarpa/Menziesia ferruginea	L		4	4			4	3							4	III
Subalpine fir/Menziesia	E										3	3				
Abies lasiocarpa/Calamagrostis rubescens	L		3	3			4	3			3	3			5	I
Subalpine fir/Bluejoint	E										3	3				
Abies lasiocarpa/Vaccinium scoparium	L		4	4			3	3								III
Subalpine fir/Grouse whortleberry	E															
Abies lasiocarpa/Vaccinium globulare	L		4	4			3	3			3	3				II
Subalpine fir/Blue huckleberry	E										4	4				

TABLE 4. Continued

Habitat Type		Hiding Cover				Thermal Cover				Forage				Special Uses		Cover Type 2/
		S	S	F	W	S	S	F	W	S	S	F	W	C	B	
Abies lasiocarpa/Xerophyllum tenax	L		4	4			3	3								II
Subalpine fir/Beargrass	E										4	4				
Abies lasiocarpa/Vaccinium caespitosum	L	3	3	3		3	3	3		3	3	3				III
Subalpine fir/Dwarf huckleberry	E									3	3	3				
Abies lasiocarpa/Luzula hitchcockii	L										3	3				IV
Subalpine fir/Smooth woodrush	E										3	3				
Abies lasiocarpa/Alnus sinuata	L		4	4			4	3								III
Subalpine fir/Mountain alder	E										3	3				
Abies lasiocarpa/Ledum glandulosum	L		3	3			3	3			3	3			5	I
Subalpine fir/Western Labrador tea	E										3	3				
Abies lasiocarpa/Caltha biflora	L		3	3			5	3			3	3			5	I
Subalpine fir/Marsh marigold	E										3	3				
Pinus flexilis/Festuca idahoensis	L												3			IV
Limber pine/Idaho fescue	E												3			
Pinus albicaulis/Abies lasiocarpa	L															IV
Whitebark pine/Subalpine fir	E															
Pinus albicaulis/Festuca idahoensis	L										3	3	3(4)			IV
Whitebark pine/Idaho fescue	E										3	3	3			
Pinus contorta/Festuca idahoensis	L		3	3			3	3						3		III
Lodgepole pine/Idaho fescue	E															
Picea engelmannii/Carex disperma	L		3	3			5	3							5	I
Englemann spruce/Soft-leaved sedge	E										3	3				

TABLE 5. Plants eaten by elk in central Idaho [1/]

Grasses	Grasses cont.
Agropyron cristatum	* *Melica bulbosa*
A. intermedium	*Oryzopsis hymenoides*
* # *A. spicatum*	* # *Phleum alpinum*
Agrostis exarata	# *P. pratensis*
* # *Bromus carinatus*	*Poa alpina*
* # *B. inermis*	*P. cusickii*
* *Calamagrostis canadensis*	*P. nervosa*
C. rubescens	*P. patersoni*
* # *Dactylis glomerata*	*P. scabrella*
* # *Danthonia intermedia*	* *P. secunda*
D. unispicata	# *Stipa columbiana (Stipa occidenta)*
# *Deschampsia caespitosa*	*S. comata*
Eleocharis acicularis	**Grasslike Plants**
Elymus flavescens	*Carex spp.*
# *E. glaucus*	* *Carex aquatilis*
* *E. glaucus var. salmonensis*	# *C. concinnoides*
* # *Festuca idahoensis*	* # *C. geyeri*
* *Hordeum brachyantherum*	
* # *Koeleria cristata*	

* Important species on the Challis and Salmon National Forests.

\# Important species on the Sawtooth National Forest.

1/ From a review of all available literature.

TABLE 5. Continued

Grasses cont.	Forbs cont.
C. rossii	*A. occidentalis*
C. vallicola	*A. perelegans*
Luzula parviflora	* *Astragalus spp.*
Forbs	* # *Balsamorhiza sagittata*
	Boykinia heucheriformis
Achillea millefolium	*Calochortus elegans*
Aconitum spp.	*C. eurycarpus*
Actaea rubra	*Castilleja chromosa*
# *Agastache urticifolia*	* # *C. miniata*
* *Agoseris spp.*	*C. lineariaefolia*
* # *Agoseris glauca*	*Chamaenerion exaltatum*
* *Allium spp.*	*Cirsium spp.*
Angelica lyallii	*Claytonia asarifolia*
Arnica cordifolia	*C. sibirica*
A. fulgens	*Clintonia uniflora*
A. latifolia	*Coptis occidentalis*
A. mollis	*Corydalis scouleri*
A. sororia	*Crepis spp.*
Asplenium cycolosorum	*Cynomarathrum machridei*
* *Aster spp.*	*Delphinium scopulorum*
A. attenuatus	*Dodecatheon conjugens*
A. eatonii	* *D. jeffreyi*
A. foliaceus	* # *Epilobium angustifolium*

TABLE 5. Continued

Forbs cont.	Forbs cont.
* *Erigeron spp.*	# *Osmorhiza occidentalis*
E. speciosus	*O. chilensis*
# *Eriogonum flavum*	*Pedicularis groenlandica*
* # *E. umbellatum*	*P. racemosa*
# *E. heracleoides*	# *Penstemon attenuatus*
Fragaria spp.	*P. confertus*
* *Franseria albicaulis*	# *P. humilis*
Gaillardia spp.	*P. pinetorum*
* *Geranium viscosissimum*	*P. procerus*
Geum triflorum	* *P. rydbergii*
# *Heracleum lanatum*	*Phacelia hiennis*
Heuchera glabella	*P. sericea*
* # *Hieracium albertinum*	*Phlox longifolia*
H. albiflorum	*Polemonium delicatum*
H. scouleri	*Polygonum phytolaccaefolium*
Hydrophyllum capitatum	*Potentilla glandulosa*
* *Lewisia rediviva*	*P. gracilis*
Ligusticum spp.	*Pteridium aquilinum*
L. tenuifolium	* *Ranunculus alismaefolius*
* *Lupinus spp.*	*R. glaberrimus*
# *Mertensia ciliata*	*Saxifraga spp.*
M. viridis	* *S. rhomboidea*
Mitella stauropetala	*Sedum lanceolatum*

TABLE 5. Continued

Forbs cont.	Shrubs cont.
* *Senecio canus*	*A. tridentata*
S. columbianus	* # *Berberis repens*
S. serra	* # *Ceanothus velutinus*
S. triangularis	* # *Cercocarpus ledifolius*
Sisyrinchium inflatum	*Chrysothamnus nauseosus*
Smilacina racemosa	* *C. viscidiflorus*
S. stellata	*Cornus stolonifera*
Sphaeralcea rivularis	*Leptodactylon pungens*
Spiranthes romanzoffiana	*Lonicera involucrata*
* # *Taraxicum officinale*	*L. utahensis*
Trifolium spp.	*Menziesia ferruginea*
Valeriana acutiloba	*Opuntia spp.*
V. sitchensis	*Physocarpus malvaceus*
Veratrum escholtzii	* # *Prunus virginiana*
Verbascum thapsus	* # *Purshia tridentata*
* # *Xerophyllum tenax*	*Rhamnus purshiana*
Zigadenus venenosus	*Ribes cognatum*
Shrubs	*R. petiolare*
	R. viscossimum
Acer glabrum	*Rosa spp.*
Alnus tenuifolia	*Rubus parviflorus*
* # *Amelanchier alnifolia*	* # *Salix spp.*
Artemisia arbuscula	* # *S. scouleriana*

TABLE 5. Continued

Shrubs cont.	
# *Sambucus cerulea*	
S. melanocarpa	
Sorbus americana	
Symphoricarpos albus	
S. oreophilus	
Tetradymia canescens	
* # *Vaccinium globulare*	
V. membranaceum	
V. scoparium	
Trees	
Pinus ponderosa	
* # *Populus tremuloides*	
Pseudotsuga menziesii	

REFERENCES

Allen, E. O. 1977. (Chairman) Montana cooperative elk-logging study. Progress report, January 1 to December 31, 1976. Montana Fish and Game Dept. Bozeman.

Altman, M. 1952. Social behavior of elk, Cervus canadensis nelsoni, in the Jackson Hole area of Wyoming. Behavior 4(2):116-143.

Anderson, C. C. 1958. The elk of Jackson Hole. Bull. 10. 184 pp. Wyo. Game and Fish Comm., Cheyenne.

Anderson, E. W. and R. J. Scherzinger. 1975. Improving quality of winter range forage for elk by cattle grazing. J. Range Manage. 28(2):120-125.

Anderson, L. D. 1980. Adjustable wire fences for facilitating big game movement. BLM, Salmon District. Technical Note #343. 7 pp.

Baglien, J. W. and D. E. Biggins. 1976. A plan for elk management by habitat manipulation. pp. 81-84. In Elk-Logging-Roads Symp. Proc., Univ. Idaho, Moscow.

Beall, R. C. 1974. Winter habitat selection and use by a western Montana elk herd. Ph. D. Diss., Univ. Montana, Missoula. 197 pp.

Black, H., R. J. Scherziner, and J. W. Thomas. 1976. Relationships of Rocky Mountain elk and Rocky Mountain mule deer habitat to timber management in the Blue Mountains of Oregon and Washington. pp 11-31. In Elk-Logging-Roads Symp. Proc., Univ. Idaho, Moscow.

Bohne, J. R. 1974. Food habitats, seasonal distribution, and habitat utilizaton of elk in the South Fork of Fish Creek, Lolo National Forest, Montana. Fish and Game Dept., Helena. Job Final Rpt. W-120-R-2,3.

Burbridge, W. R. and D. J. Neff. 1976. Coconino National Forest-Arizona Dept. of Game and Fish Cooperative Roads-Wildlife Study. pp 44-57. In Elk-Logging-Roads Symp. Proc., Univ. Idaho, Moscow.

Butler, B. R. 1968. A guide to understanding Idaho archaeology. Soc. Ed. (Special publication of Idaho State Univ. Museum, Pocatello). 170 pp.

Carrier, W. D. and Associates. 1977. Elk habitat coordinating guidelines for northern Idaho. A cooperative effort between the U.S. Forest Service, Idaho Dept. of Fish and Game, Bureau of Land Management, and Univ. of Idaho. 46 pp.

Chadwick, H. W. 1960. Plant succession and big-game winter movements and feeding habits in a sand dune area in Fremont County, Idaho. M.S. Thesis, Univ. Idaho, Moscow. 121 pp.

Coggins, V. 1976. Controlled vehicle access during elk season in the Chesnimnus area, Oregon. pp. 58-61. In Elk-Logging-Roads Symp. Proc., Univ. Idaho, Moscow.

Coggins, F. L. and K. W. Zobell. 1972. The effect of vehicle restrictions on elk harvest and hunter behavior in the Chesnimnus Game Management Unit. M.S. report from Ore. State Game Comm. and USDA Forest Service, Wallowa Natl. Forest. 5 pp.

Cole, G. F. 1958. Big game-livestock competition on mountain rangelands. Montana Wild. (April):24-30.

Cooney, R. F. 1952. Elk problems in Montana. J. Range. Manage. 5(1):3-7.

Coop, K. J. 1971. Habitat use, distribution, movement, and associated behavior of elk, Little Belt Mountains, Montana. M.S. Thesis, Mont. State Univ., Bozeman. 61 pp.

Coues, E. 1893. (Dover. Pubs., Inc. 1965). History of the expedition under the command of Lewis and Clark. Vol. II. p. 537.

Craighead, J. J. 1952. A biological and economic appraisal of the Jackson Hole elk herd. N.Y. Zool. Soc. and Conservation Foundation. New York, N.Y. 32 pp.

Dalke, P. D., R. D. Beeman, F. J. Kindel, R. J. Robel, and T. R. Williams. 1965. Use of salt by elk in Idaho. J. Wild. Manage. 29(2):319-332.

Davis, J. L. 1970. Elk use of spring and calving range during and after controlled logging. M.S. Thesis, Univ. Idaho, Moscow. 51 pp.

Denio, R. M. 1938. Elk and deer foods and feeding habits. Trans. North Amer. Wildl. Conf. 3:421-427.

de Vos, A., P. Brock, and V. Geist. 1967. A review of social behavior of the North American cervids during the reproductive period. Amer. Midl. Natur. 77(2):257-543.

Dyrness, C. T. 1973. Early stages of plant succession following logging and burning on the Western Cascades of Oregon. Ecology 54(1):57-69.

Edgerton, P. J. and J. Smith. 1971. Seasonal forage use by deer and elk on the Starkey Experimental Forest and Range, Oregon. USDA For. Serv. Res. Pap. PNW 112. 12 pp.

Edgerton, P. J. 1972. Big-game use and habitat changes on a recently logged mixed conifer Forest in north eastern Oregon. Proc. Annual Conf., Western Assoc. State Fish and Game Commissioners. 52:239-246.

Eustace, C. D. 1967. Food habits, range use, and relationships between elk and livestock in the Gravelly Mountains, Montana. M.S. Thesis, Montana State Univ., Bozeman. 55 pp.

Graves, H. S. and E. W. Nelson. 1919. Our national elk herds. A program with special reference to the elk on the National Forests adjacent to the Yellowstone National Park. U.S. Dept. Agri. Dept. Circ. 51. 34 pp.

Grieb, R. and R. N. Denny. 1965. Game research in Colorado. Game Research Review, Colorado Div. of Fish, Game, and Parks, Denver. 35 pp.

Grkovic, N. 1976. Montana-Idaho elk migration and key-use area study, Salmon, Beaverhead, and Bitterroot National Forests. M.S. Thesis, Univ. Montana, Missoula. 127 pp.

Gruell, G., G. Roby, C. Thompson, and K. Schmidlin. 1978-1979 Progress report Gros Ventre cooperative elk study. 154 pp. Bridger-Teton Nt. For., Jackson Hole, Wyoming.

Hall, F. C. 1977. Ecology of natural underburning in the Blue Mountains of Oregon. USDA Forest Service, Pacific Northwest Region, R-6 Ecol. 79:1-11.

Hansen, R. M. and L. D. Reid. 1975. Diet overlap of deer, elk, and cattle in southern Colorado. J. Range Manage. 28(1):43-47.

Harper, J. A., J. H. Harn, W. W. Bentley, and C. F. Yocum. 1967. The status and ecology of the Roosevelt elk in California. Wildl. Monogr. No. 16. 49 pp.

Hayden-Wing, L. D. 1978. Elk use of mountain meadows in the Idaho Primitive Area. pp. 40-46. In Boyce, M. S. and Hayden-Wing, L. D. (editors) North American elk:ecology, behavior and management. Univ. of Wyoming, Laramie. 249 p.

Hershey, T. J. and T. A. Leege. 1976. Influences of logging on summer range in north central Idaho. pp. 73-80. In Elk-Logging-Roads Symp. Proc., Univ. Idaho, Moscow.

Holechek, J. L. 1980. Concepts concerning forage allocation to livestock and big game. Rangeland 2(4):158-159.

Hoskins, L. W. 1953. Browse utilization studies on the Pocatello winter big-game range. M.S. Thesis, Univ. of Idaho, Moscow. 87 pp.

Hudson, R. J., D. M. Herbert, and V. C. Brink. 1976. Occupational patterns of wildlife on a major East Kootenay winter-spring range. J. Range Manage. 29(1):38-43.

Hurd, R.M. and N.A. Kissinger, Jr. 1953. Estimating utilization of Idaho fescue on cattle range by percent of plant grazed. Rocky Mtn. For. and Range Exp. Sta., Paper 12. 5 pp.

Idaho Fish and Game Commission. 1978. A plan for the future management of Idaho's fish and wildlife resources. Vol. 1, Goals, Objectives, and Policies, 1975-1990. Boise. 170 pp.

Irving, W. 1843. The adventures of Captain Bonneville. Handy Volume ed., New York:Putnam. 38 pp.

Jeffrey, D. E. 1963. Factors influencing elk and cattle distribution on Willow Creek summer range, Utah. M.S. Thesis, Utah State Univ., Logan. 46 pp.

Julander, O. and D. E. Jeffery. 1964. Deer, elk, and cattle range relations on summer range in Utah. Trans. N. Amer. Wildlife and Nat. Resour. Conf. 29:404-413.

Kirsch, J. B. 1962. Range use, relationships to logging and food habits of the elk in the Little Belt Mountains, Montana. M.S. Thesis, Montana State College, Bozeman. 44 pp.

Komberec, T. C. 1976. Range relationship of mule deer, elk, and cattle in the "breaks" habitat of eastern Montana. Montana Dept. Fish and Game, Job Compl. Re. W-120-R-6, 7. 79 pp.

Krueger, W. C. and A. H. Winward. 1974. Influence of cattle and big-game grazing on understory structure of a Douglas fir-ponderosa pine-Kentucky bluegrass community. J. Range Manage 27(6):450-653.

Lauer, L. 1973. A vegetational inventory of big-game winter range in the Salmon River Canyon. M.S. Thesis, Univ. Idaho, Moscow. 62 pp.

Leege, T. A. 1974. Effects of logging on elk in Pete King Creek-Lochsa River drainage. (Unpublished report for NezPerce National Forest, Grangeville, Dec. 3, 1974). 5 pp.

Leege, T. A., M. W. Schlegel, and T. J. Hershey. 1976. Elk ecology. Job Progress Rept. W-160-R-3. Idaho Dept. of Fish and Game, Boise. 70 pp.

Lemke, T. O. 1975. Movement and seasonal ranges of the Burdetts Creek elk herd and an investigation of sport hunting. M.S. Thesis, Univ. Montana, Missoula. 127 pp.

Lonner, T. N. 1978. Job II-B, Long Tom Creek Study. pp 15-56. In Annual Progress Report of Montana Cooperative Elk Logging Study.

Lyon, L. J. 1975. Coordinating forestry and elk management in Montana; initial recommendations. Trans. N. Amer. Wildlife Conf. 49:193-201.

Lyon, L. J. 1976. Elk use as related to characteristics of clearcuts in western Montana. pp. 69-72. In, Elk-Logging-Roads Symp. Proc., For., Wildlf., and Range Expt. Sta., Univ. Idaho, Moscow. 142 pp.

Lyon, L. J. 1979. Habitat effectiveness for elk as influenced by roads and cover. J. Forestry 77(1):658-660.

Mackie, R. J. 1970. Range ecology and relations of mule deer, elk, and cattle in the Missouri River Breaks, Montana. Wildl. Monogr. 20. 79 pp.

Marcum, C. L. 1976. Habitat selection and use during summer and fall months by a western Montana elk herd. pp. 91-96. In, Elk-Logging-Roads Symp. Proc., Univ. Idaho, Moscow.

McCulloch, C. Y., Jr. 1955. Utilization of winter browse on wilderness big-game range. J. Wildl. Manage. 19:206-215.

McCullough, D. R. 1969. The Tule elk: its history, behavior, and ecology. Univ. California, Berkeley. Publ. Zool. 88:1-209.

Mitchell, G. E. and J. B. Lauckhart. 1948. Management of the Yakima Rocky Mountain elk herd. Trans. N. Amer. Wildl. Conf. 13:401-409.

Morgan, D. 1953. Jedediah Smith and the opening of the West. Bobbs-Merrill, Indianapolis. 458 pp.

Morris, M. S. 1956. Elk and livestock competition. J. Range. Manage. 9(1):11-14.

Mueggler, W. F. 1965. Ecology of seral shrub communities in the cedar-hemlock zone of northern Idaho. Ecol. Monogr. 35:165-185.

Mueggler, W. F. 1967. Trees, shrubs, and elk. Idaho Wildlf. Rev., Idaho Dept. of Fish and Game. 19(1):12-13.

Murie, O. J. 1951. The elk of North America. The Stackpole Co., Harrisburg, Penn. 376 pp.

Nagle, J. P. and G. A. Harris. 1966. Grazing compatibility of cattle and elk on mountain ranges. Helsinki, Finland. Intern. Grassland Cong., Sec. 4, Paper No. 44:184-187.

Nelson, J. R. and D. G. Burnell. 1975. Elk-cattle competition in central Washington. 172 pp. In Range multiple use management. Univ. Idaho, Moscow.

Peek, J. M. 1979. Comments on big-game/access relationships. Wildlife Mgmt. Workshop. Colorado State Univ. 12 pp.

Pengelly, W. L. 1966. Ecological effects of slash disposal fires on the Coeur d'Alene National Forest, Idaho. USDA Forest Service, Missoula, MT. 22 pp.

Perry C. and R. Overly. 1976. Impact of roads on big-game distribution in portions of the Blue Mountains of Washington. pp. 62-68. In Elk-Logging-Roads Symp. Proc., Univ. of Idaho, Moscow.

Pfister, R. D., R. Steele, R. A. Ryker, and J. A. Kittams. 1974. Preliminary forest habitat types of the Challis, Salmon, and Sawtooth National Forests. USDA Forest Service, Intermtn. Sta. and Reg. 4. 72 pp.

Phillips, T. A. 1974. Characteristics of elk calving habitat on the Sawtooth National Forest. USDA For. Serv., Region 4, Ogden, UT. Range Imprvt. Notes 19(1):1-5.

Pickford, G. D. and E. H. Reid. 1943. Competition of elk and domestic livestock for summer range forage. J. Wildl. Manage. 7(3):323-332.

Picton, H. D. 1976. The Gallatin human-wildlife community, Montana. MSU, NSF, Gallatin Canyon Study: Res. Monog. #181. Inst. for Applied Research, Montana State Univ., Bozeman. 56 pp.

Picton, H. D. and I. E. Picton. 1975. Saga of the sun-a-history of the Sun River elk herd. Mont. Dept. Fish and Game. 55 pp.

Preble, E. A. 1911. Report on conditions of elk in Jackson Hole, Wyoming, in 1911. USDA Biol. Bull. 40. 23 pp.

Rasmussen, D. I. 1949. The American elk or wapiti today. Trans. N. Amer. Wildl. Conf. 14:513-526.

Ream, R. R., R. Beall, and C. L. Marcum. 1974. Sapphire Divide Study. pp. 85-103. In Montana Coop. Elk-Logging Studies, Prog. Rept., E. O. Allen, Chmn., Aug. 1974.

Roberts, H. B. 1974. Effects of logging on elk calving habitat, Moyer Creek, Salmon, Idaho. USDA For. Serv., Reg. 4. 22 pp.

Rost, G. R. and J. A. Bailey. 1979. Distribution of mule deer and elk in relation to roads. J. Wildl. Manage. 43(3):634-641.

Sadek, H. 1965. Distribution of the bird remains at Jaguar Cove. Idaho State Univ. Museum, Pocatello. Tebiwa 8(1):20-28.

Schlegel, M. W. and T. A. Leege. 1972. Movements and harvest of Glover Ridge elk. Idaho Wildl. Rev., Idaho Fish and Game Dept., Boise. 25(2):3-6.

Schultz, R. D. and J. A. Bailey. 1978. Responses of National Park elk to human activity. J. Wildl. Manage. 43(1):91-100.

Skovlin, J. M., P. J. Edgerton, and R. W. Harris. 1968. The influence of cattle management on deer and elk. Trans. N. Amer. Wildl. Nat. Resour. Conf. 33:169-181.

Skovlin, J. M. and R. W. Harris. 1976. Management of conifer woodland grazing resources for cattle, deer, and elk. Inter. Grassland Cong. Proc. 11:75-78.

Smith, D. R. 1961. Competition between cattle and game on elk winter range. USDA Bull. 377, Univ. of Wyoming Agri. Exp. Station. 15 pp.

Springfield, H.W. and G. Peterson. 1964. Use of the grazed-plant method for estimating utilization of some range grasses in New Mexico. Rocky Mtn. For. and Range Exp. Sta., U.S. Forest Service, Res. Note RM-22. 6 pp.

Stark, R. H. 1973. Elk-cattle inter-relations on Colockum Creek watershed. M.S. Thesis, Washington State Univ., Pullman. 87 pp.

Stevens, D. R. 1966. Range relationships of elk and livestock, Crow Creek drainage, Montana. J. Wildl. Manage. 30(2):349-363.

Taylor, W. P. 1956. The deer of North America: The Stackpole Co., Harrisburg, Penn. 668 pp.

Thiessen, J. L. 1976. Some relations of elk to logging, roading, and hunting in Idaho Game Management Unit 39. pp. 3-5. In Elk-Logging-Roads Symp. Proc., Univ. Idaho, Moscow.

Trout, L. C. and T. A. Leege. 1971. Are the northern Idaho elk herds doomed? Idaho Wildl. Rev., Idaho Fish and Game Dept., Boise. 24(3):3-5.

Tueller, P. T. and A. L. Lesperance. 1970. Competitive use of Nevada's range forage by livestock and big game. Trans. Wildl. Soc. Calif/Nevada, Sec. 10:129-137.

Ward, A. L. 1973. Elk behavior in relation to multiple uses on the Medicine Bow National Forest. West. Assoc. Game and Fish Comm. Proc. 53:125-139.

Ward, A. L. 1976. Elk behavior in relation to timber harvest operations and traffic on the Medicine Bow Range in south-central Wyoming. pp. 32-43. In Elk-Logging-Roads Symp. Proc., Univ. Idaho, Moscow.

Ward, A. L., K. L. Diem, and R. W. Weeks. 1975. The impact of snow on elk. In Final Report of Medicine Bow. Ecology Project D. Knight (ed.), Univ. Wyoming, Laramie. 380 pp.

Will, G. C. 1979. Size of spring-summer-fall elk home range in Region 4. In Elk surveys and inventories, Fed. Aid Proj. W-170-R-3, Appendix 3. pp. 246-249. Idaho Dept. of Fish and Game, July 1, 1978, to June 30, 1979.

Wing, L. D. 1962. Big-game and livestock browse utilization and feeding habits on a sandy range in southeastern Idaho. M. S. Thesis, Univ. Idaho, Moscow. 89 pp.

Wittinger, W. T. 1978. Habitats, food habits, and range use of mule deer, elk, and cattle on the Herd Creek rest-rotation grazing system--East Fork of the Salmon River, Idaho. M.S. Thesis, Univ. Idaho, Moscow. 125 pp.

Work, J. 1923. The journal of John Work, Edward W. Lewis, and P. Phillips. 209 pp. Cleveland: A. H. Clark Co.

Yeo, J. 1980. Habitats, food habits, and range use of mule deer, elk, and cattle on the Herd Creek rest-rotation grazing system--East Fork of the Salmon River, Idaho. M.S. Thesis, Univ. Idaho, Moscow. (In progress).

Young, V. A. and W. L. Robinette. 1939. A study of the range habits of elk on the Selway Game Preserve., Univ. Idaho, Moscow. Bull. 34(16):1-48.

Zahn, H. M. 1974. Seasonal movements of the Burdette Creek elk herd. M.S. Thesis, Univ. Montana, Missoula. 71 pp.

FORM 1

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL

Area: _____
Alternative: _____
Calculated by: _____
Date: _____

1. Change in potential elk use because of alteration in cover.

Total usable acres in home range* _____ (A)

Total acres in hiding and thermal cover _____ (B)

Percent of usable acres in cover (B)÷(A) _____ (C)

Forest habitat type	Curve type (Table 4 appendix)	Total usable acres in habitat type (group) (D)	Percent of all acres (D)÷(E) (F)	Percent of maximum potential elk use (use (C) and Fig. 4) (G)	Weighted use factor (F)X(G) (H)	Weighted percent max. potential elk use (I)÷100 (J)	Percent below max. potential elk use (100)-(J) (K)
	I						
	II						
	III						
	IV						
TOTALS		(E)	100		(I)	____%	____%

2. Change in potential elk use because of roads.

Total usable acres more than one-half mile away from open road _____ (L)

Total acres affected by roads (A)-(L) _____ (M)

Acres affected by each type of road in each vegetation type:

Road type[1]	Vegetation type[1]	Miles (N)	Proportion of total (N)÷(Ø) (P)	Acres affected (P)X(M) (Q)	Usability factor[2] (R)	Acres usable at 100% (Q)X(R) (S)
Main	Dense forest				.7	
	Open forest				.5	
	Clearing				.3	
Secondary	Dense forest				.8	
	Open forest				.65	
	Clearing				.5	
Primitive	Dense forest				.9	
	Open forest				.8	
	Clearing				.7	

TOTALS _____ (Ø) 1.0 TOTAL _____ (T)

Disturbed acres on both sides of all open roads (Ø)X(640) _____ (U)

Factor indicating overlap of road disturbance zones (M)÷(U) _____ (V)

Acres in road disturbance zone usable at 100% (T)X(V) _____ (W)

Total acres within home range usable at 100% (L)+(W) _____ (a)

Percent of home range usable at 100% (a)÷(A) _____ (b)

Change in potential elk use on home range because of road influences (100)-(b) _____ (X)

---

* Non-use areas: talus, water surface, and other areas elk would not use because of **natural** features.

[1] Refer to footnotes in Table 1, p. 19, for definitions of road and vegetation types.

[2] These figures derived from Table 1, p. 19

FORM 2

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL (Continued)

Area: _____
Calculated by: _____
Date: _____

	Pasture	(a) Suitable Grazing Acres	(c) Actual or expected use rate in % Year 1	2	3	4	5	6	(d) Weighted use factor for each yr. ($a_x c$) Year 1	2	3	4	5	6	(f) Average % use factor for each year (e ÷ b) Year 1	2	3	4	5	6	(h) Total of (g) for all years
Alternative A	A																				
	B														(g) % reduction in elk use for each year from Figure 3						(i) Average reduction in elk use during the rotation cycle (h ÷ no. yrs/cycle) =
															Year 1	2	3	4	5	6	(j) Average for entire home range $\frac{(b)x(i)}{\text{No. of acres in home range}}$ =
TOTALS		(b)							(e)												

4. Change in potential elk use because of other factors (Z) (Refer to Table 2, p. 38.)

	Natural[1]	Pre-Activity	Alt. A		
Size and interspersion of forage areas					
Ratio, size, and distribution ot thermal and hiding cover, and travel lanes					
Adequacy of security area					
Level of forage production in feeding areas					
TOTAL change from other factors (Z)					

5. Summary of predicted changes in maximum potential use.

	Natural[1]	Habitat Effectiveness	Pre-Activity	Habitat Effectiveness	Post-Activity Alternative A	Habitat Effectiveness
Maximum potential elk use of home range						
Cover: forage ratios						
Change from suboptimal cover (K)						
Change from road influences (X)						
Change from livestock influences (j)						
Change from other factors (Z)						
Percent of maximum potential elk use						
Change in potential elk use from pre-activity situation						

[1] Condition prior to any activity.

FORM 2

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL (Continued)

Area: _____
Calculated by: _____
Date: _____

Alternative A

Pasture	(a) Suitable Grazing Acres	(c) Actual or expected use rate in % Year						(d) Weighted use factor for each yr. ($a_x c$) Year						(f) Average % use factor for each year (e ÷ b) Year						(h) Total of (g) for all years
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	
A																				
B														(g) % reduction in elk use for each year from Figure 3						(i) Average reduction in elk use during the rotation cycle (h ÷ no. yrs/cycle) =
																				(j) Average for entire home range $\frac{(b)x(i)}{\text{No. of acres in home range}}$ =
														Year						
														1	2	3	4	5	6	
TOTALS	(b)							(e)												

FORM 1

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL

Area: _____
Alternative: _____
Calculated by: _____
Date: _____

1. Change in potential elk use because of alteration in cover.

Total usable acres in home range* _____ (A)

Total acres in hiding and thermal cover _____ (B)

Percent of usable acres in cover (B)÷(A) _____ (C)

Forest habitat type	Curve type (Table 4 appendix)	Total usable acres in habitat type (group) (D)	Percent of all acres (D)÷(E) (F)	Percent of maximum potential elk use (use (C) and Fig. 4) (G)	Weighted use factor (F)X(G) (H)	Weighted percent max. potential elk use (I)÷100 (J)	Percent below max. potential elk use (100)-(J) (K)
	I						
	II						
	III						
	IV						
TOTALS		(E)	100		(I)	____%	____%

2. Change in potential elk use because of roads.

Total usable acres more than one-half mile away from open road _____ (L)

Total acres affected by roads (A)-(L) _____ (M)

Acres affected by each type of road in each vegetation type:

Road type[1]	Vegetation type[1]	Miles (N)	Proportion of total (N)÷(Ø) (P)	Acres affected (P)X(M) (Q)	Usability factor[2] (R)	Acres usable at 100% (Q)X(R) (S)
Main	Dense forest				.7	
	Open forest				.5	
	Clearing				.3	
Secondary	Dense forest				.8	
	Open forest				.65	
	Clearing				.5	
Primitive	Dense forest				.9	
	Open forest				.8	
	Clearing				.7	

TOTALS _____ (Ø) 1.0 TOTAL _____ (T)

Disturbed acres on both sides of all open roads (Ø)X(640) _____ (U)

Factor indicating overlap of road disturbance zones (M)÷(U) _____ (V)

Acres in road disturbance zone usable at 100% (T)X(V) _____ (W)

Total acres within home range usable at 100% (L)+(W) _____ (a)

Percent of home range usable at 100% (a)÷(A) _____ (b)

Change in potential elk use on home range because of road influences (100)-(b) _____ (X)

---

* Non-use areas: talus, water surface, and other areas elk would not use because of **natural** features.

[1] Refer to footnotes in Table 1, p. 19, for definitions of road and vegetation types.

[2] These figures derived from Table 1, p. 19.

FORM 2

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL (Continued)

Area: _____
Calculated by: _____
Date: _____

Alternative A

Pasture	(a) Suitable Grazing Acres	(c) Actual or expected use rate in % Year 1	2	3	4	5	6	(d) Weighted use factor for each yr. ($a_x c$) Year 1	2	3	4	5	6	(f) Average % use factor for each year (e ÷ b) Year 1	2	3	4	5	6	(h) Total of (g) for all years
A																				
B														(g) % reduction in elk use for each year from Figure 3 Year 1	2	3	4	5	6	(i) Average reduction in elk use during the rotation cycle (h ÷ no. yrs/cycle) =
																				(j) Average for entire home range (b)x(i) / No. of acres in home range =
TOTALS	(b)							(e)												

4. Change in potential elk use because of other factors (Z) (Refer to Table 2, p. 38.)

	Natural[1]	Pre-Activity	Alt. A		
Size and interspersion of forage areas					
Ratio, size, and distribution ot thermal and hiding cover, and travel lanes					
Adequacy of security area					
Level of forage production in feeding areas					
TOTAL change from other factors (Z)					

5. Summary of predicted changes in maximum potential use.

	Natural[1]	Habitat Effectiveness	Pre-Activity	Habitat Effectiveness	Post-Activity Alternative A	Habitat Effectiveness
Maximum potential elk use of home range						
Cover: forage ratios						
Change from suboptimal cover (K)						
Change from road influences (X)						
Change from livestock influences (j)						
Change from other factors (Z)						
Percent of maximum potential elk use						
Change in potential elk use from pre-activity situation						

[1] Condition prior to any activity.

FORM 2

CENTRAL IDAHO

ESTIMATING THE QUALITY OF ELK HABITAT IN RELATION TO ITS POTENTIAL (Continued)

Area: _____
Calculated by: _____
Date: _____

Alternative A

Pasture	(a) Suitable Grazing Acres	(c) Actual or expected use rate in % Year						(d) Weighted use factor for each yr. (a x c) Year						(f) Average % use factor for each year (e ÷ b) Year						(h) Total of (g) for all years
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	
A																				
B														(g) % reduction in elk use for each year from Figure 3						(i) Average reduction in elk use during the rotation cycle (h ÷ no. yrs/cycle) =
																				(j) Average for entire home range (b)x(i) / No. of acres in home range =
														Year						
														1	2	3	4	5	6	
TOTALS	(b)							(e)												

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